# NATIONAL SECURITY ASSESSMENT OF THE U.S. CARTRIDGE AND PROPELLANT ACTUATED DEVICE INDUSTRY

*Third Review*

A Report for the U.S. Department of the Navy

*by the*

U.S. Department of Commerce
Bureau of Industry and Security
Office of Strategic Industries and Economic Security

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## Executive Summary

This study is the second update of the 1995 *National Security Assessment of the Cartridge and Propellant Actuated Device (CAD/PAD) Industry*. The first update was released in 2000. The U.S. Department of Commerce, Bureau of Industry and Security (BIS), Office of Strategic Industries and Economic Security (OSIES) performed this assessment at the request of the CAD/PAD Joint Program Office located at the Naval Surface Warfare Center (NSWC), Indian Head Division in Indian Head, Maryland.

BIS is delegated authority under Section 705 of the Defense Production Act of (1950), (50 U.S.C. §§ 2061-2170) as amended, and under Executive Order 12656, as amended, to collect basic economic and industrial information to fulfill the Department's responsibilities regarding the health and competitiveness of defense-related sectors and technologies. OSIES is the operating unit within BIS with the responsibility for this data collection and analysis function.

The objective of the study is to analyze the current and long-term health and economic competitiveness of the CAD/PAD industry and to develop recommendations for the Navy to ensure the continued ability of the industry to support defense missions and programs. BIS developed and disseminated a survey that asked companies to comment on industry and product-specific issues, manufacturing processes, shipping data, financial information, competitive prospects, research and development, and technical capabilities. The survey also asked the companies to comment on their relationships with the U.S. Government, and solicited their opinions on how to improve upon any noted deficiencies. Survey data was supplemented with field visits to select CAD/PAD manufacturers, discussions with industry experts, and consultations with Indian Head representatives.

### Industry and Product Assessment

CADs and PADs are explosive devices used in aircraft and missiles to perform a variety of functions such as aircrew escape, stores release, and other applications. There are about 3,000 different design configurations in use by the military services and NASA. Many are aircrew-

rated and must perform to a very high standard of performance and reliability. All have a finite service life and must be replaced periodically. CADs are also used in automotive applications to deploy airbags.

Cartridges use precisely measured propellant and explosive mixtures of varying composition and burning characteristics to perform the required functions. CAD/PAD items have requirements to operate over a range of time from milliseconds for impulse cartridges to seconds for delay cartridges and rocket motors. The cost of the CAD/PAD items varies from as little as one dollar to over $10,000.

Included among the many different CAD/PAD products are detonators, detonating and thin layer explosive cords, percussion primers, electric ignition elements, laser initiators, pyrotechnic delays, thermal elements, rocket catapults, underseat rocket motors, thrusters, cutters, and water-actuated pyrotechnic devices.

At present, the U.S. CAD/PAD industry consists of 25 manufacturers across 20 states. Of these, 12 manufacturers are making only defense products. Eleven companies are involved in mostly defense work, with small commercial orders used primarily for space applications. Two companies are almost entirely commercial, manufacturing automobile airbag components.

Defense CAD/PAD work uses less automation for lower volume orders, whereas commercial (i.e., airbag) work is automation-intensive and high volume. This is not surprising, however, because the relatively low order volumes for defense contracts do not justify a high degree of automation. Data for 2001 to 2005 confirmed that the commercial sector is now 60 percent larger than the defense sector in terms of shipments.

Industry Performance

U.S. defense and commercial CAD/PAD manufacturers have evolved sufficiently and are no longer part of the same industry. This coincides with changes noted in the BIS 1995 and 2000 national security assessments of the CAD/PAD industry, indicating an increasingly divergent

trend in the aerospace and automotive sectors. Shipments have been the primary factor in this separation. During 2001-2005, defense shipments grew slowly. However, since the 2000 study, commercial shipments more than doubled, putting a statistically significant distance between defense and commercial CAD/PAD manufacturing.

Levels of defense shipments of individual CAD/PAD product categories were mixed during 2001-2005. New orders for two of the primary products of the defense CAD/PAD sector – ejection seat system CAD/PADs and rocket motors - were flat. Future shipments will depend on U.S. manufacturers' access to the Joint Strike Fighter (JSF) and the Joint Primary Air Training System (JPATS) ejection system and related CAD/PAD program work. Currently, these programs are dominated by a foreign firm, Martin-Baker Aircraft of the United Kingdom.

Shipments of consumable CAD/PADs, like electronic impulse cartridges and aircraft stores (for countermeasures dispersal) are tied closely to war fighting and have seen significant increases in 2001-2005 since the beginning of U.S. military operations in Afghanistan and Iraq. Demand for these items is unlikely to decrease in the near-term.

The operating income of defense CAD/PAD companies (as a percentage of shipments) grew modestly during 2001-2005. Defense CAD/PAD companies turned an operating profit each year during 2001-2005, indicating that these firms are effectively managing costs in times of leaner sales.

Capital expenditures at defense CAD/PAD companies decreased over 30 percent from 2001 to 2005. However, capital expenditures in 2005 were still slightly higher than expenditures noted in the 1995 and 2000 BIS reports, indicating an interest in rebuilding capacity, tooling, and other hardware.

Research and development (R&D) spending in 2001-2005 for both the defense and commercial CAD/PAD sectors was significantly higher across the board than in previous BIS assessments. However, there is little U.S. Government-funded R&D supporting the defense manufacturers. Large in-house allocations are being utilized to support next-generation technology.

Employment levels for defense CAD/PAD producers rose 12 percent during 2001-2005; however, the 2005 level did not reach the employment levels found in the 2000 and 1995 studies.

Exports of defense CAD/PAD products did not represent a significant share of overall industry shipments, averaging about 7 percent during the current study period. This was not unexpected, as the prior BIS CAD/PAD industry assessments also reported low defense exports.

Competitive Assessment

Due to the overall slowdown in military aircraft exports, smaller than expected orders for new U.S. fighter aircraft like the F-22, and the retirement of many legacy aircraft (i.e., F-16), U.S. market share in ejection system CAD/PADs is at risk of diminishing sharply in the next decade, possibly leading to a loss of some domestic manufacturing capability for ejection system CADs and PADs. This concern was previously raised in the BIS 2000 report.

Domestic competition with Martin-Baker Aircraft for ejection system CAD/PAD work remains an issue from the 2000 BIS assessment. Martin-Baker won the ejection seat contracts for the JSF and JPATS aircraft. The JSF is projected to sell between 3,000-4,500 planes worldwide. In addition, the JPATS aircraft contains two ejection seats and is projected to sell an initial quantity of 782 planes through 2017, nearly half of which had been sold as of April 2006. In comparison, the F-22 ejection seat contract has been systematically scaled back by the U.S. Department of Defense from 750 to 180 aircraft.

On the commercial side, new U.S. safety regulations requiring side airbags in every domestically-produced automobile and light truck beginning in 2009 will increase demand for airbag components, causing their shipment growth over the next five years to possibly double or triple.

Acquisition of raw materials on the global open market has become more expensive, making it more difficult for defense CAD/PAD companies to compete for U.S. government contracts.

International competitors for these materials, like China and India, consume more and drive up the price of critical materials. Several companies listed lead azide – an important explosive component for CAD/PADs – as increasingly difficult to obtain. In terms of supply sourcing disruptions, companies reported very few foreign or domestic sourcing constraints, and none listed foreign sourcing as a serious problem.

Factors Affecting the CAD/PAD Industry

Since September 11, 2001, companies noted a problem in export licensing, which now can take months to obtain instead of a few weeks, as was the case in the 1990s. Companies further responded through BIS industry survey that delays in export licensing negatively affect "time to market" and hamper international competition. Survey respondents specifically stated that they are increasingly losing military sales to overseas competitors because of delays resulting from the U.S. State Department-administered export licensing process. Based on the reassignment of airbags from the U.S. Munitions List (USML) to the Commerce Control List several years ago, some U.S CAD/PAD companies are preparing to seek commodity jurisdiction for currently USML-controlled military CAD/PADs to allow their use in non-DOD satellites and other commercial space applications.

The U.S. Government-mandated program to begin dual-sourcing all CAD/PAD products by 2007 is of universal concern among CAD/PAD manufacturers. Starting in 2007, the JPO will require all CAD/PADs to have two domestic sources of production. Dual-sourcing of defense CAD/PAD contracts between competing U.S. companies can put more pressure on smaller firms with low volume operations to compete. While dual-sourcing is a good idea for the industry (especially for high volume ejection system CAD/PAD components), and for the U.S. defense industrial base as a whole, it has the potential to drive smaller companies from the CAD/PAD industry. Dual-sourcing makes sense for larger volume contracts, where the sharing of work will not adversely impact a small producer who may have relied on a specific volume for many years. However, dual-sourcing of small volume contracts could have a negative impact, since the production volume required by DOD will be insufficient to warrant competitive bidding by CAD/PAD firms.

The U.S. Department of Transportation shipping classifications approval process also remains a concern for many of the defense CAD/PAD companies that responded to the survey. Some companies are now using authorized outside contractors to fulfill this need. Delays in receiving these classifications are slowing the shipment of product to subcontractors, and even more importantly, to customers.

Instead of the past industry standard of "build to print" manufacturing specifications, companies overwhelmingly favored using performance specifications. "Build-to-print" contracts often require greater resources to complete. Any customization can also stretch out product development timeframes, which alters project scope and potentially lowers profit margins on defense contracts. Performance specifications allow more modern and efficient technologies to be used in developing and producing products.

While the Naval Surface Warfare Center (NSWC) at Indian Head is still requiring lot acceptance testing at its facility for Navy-administered contracts, CAD/PAD companies would prefer to conduct testing and approve results at their own manufacturing facilities to save processing time and costs and increase speed to market. This preference was previously identified in the BIS 2000 report.

The underutilization of Small Business Set-Asides continues to be an issue, as many small CAD/PAD producers are not taking full advantage of government-afforded benefits associated with the program. This is also a contentious issue, as some small companies believe that larger competitors may try to acquire small firms simply to obtain Set-Asides.

<u>Findings and Recommendations</u> - See Chapter 6

# 1. Introduction

## 1.1 Background

This report is an update of the December 2000 *National Security Assessment of the Cartridge and Propellant Actuated Device (CAD/PAD) Industry*. This report and the previous two studies were initiated at the request of the U.S. Department of the Navy, CAD/PAD Joint Program Management Office, Naval Surface Warfare Center (NSWC) located in Indian Head, Maryland.[1]

Cartridge actuated devices (CADs) and propellant actuated devices (PADs) are manufactured components that use explosive and propellant mixtures to perform a variety of specialized work functions. Defense and commercial functions include the ejection of aircrews from aircraft in emergency situations; separation of satellites from launch vehicles; cutting cables to deploy parachutes; and the generation of gas to inflate automotive airbags.

The U.S. Department of Commerce (DOC), Bureau of Industry and Security (BIS) is delegated authority under Section 705 of the Defense Production Act (DPA) of 1950, as amended, and under Executive Order 12656, as amended, to collect economic and industrial data from U.S. businesses. This data is then utilized to develop defense industrial base assessments. The Office of Strategic Industries and Economic Security (SIES) is the operating unit within BIS with the responsibility for this data collection and analysis. The U.S. Navy and the other Services have an established history of cooperative study efforts with BIS that has resulted in more than 45 national security assessments in the past 20 years.

This national security assessment reviewed the five-year period from 2001-2005; the previous assessments covered the periods from 1995-1999 and 1991-1995, respectively. The stated objective of this study was to provide the U.S. Navy with an updated statistical profile of the CAD/PAD industry by assessing its current economic health and competitiveness.

[1] http://www.ih.navy.mil/

## 1.2 Methodology and Scope

The BIS methodology for evaluating the U.S. CAD/PAD industry is the same as that utilized during the initial study in 1995. The survey sent to the industry was designed with the assistance of the CAD/PAD Joint Program Office and field tested with a select number of firms. Justification for this data collection was provided to the Office of Management and Budget (OMB) as required under the Paperwork Reduction Act of 1978, as amended under regulation 5 CFR 1320. A copy of the approved survey can be found in Appendix F.

In October 2005, the CAD/PAD survey was electronically distributed to 45 companies believed to be involved in the industry. Some companies were later excluded from the survey for various reasons. Subsequent research revealed that three firms had gone out of business since the publication of the 2000 report; five companies were initially thought to produce CAD/PADs, but in fact did not; eight companies had not produced CAD/PAD items in the last five years, and four companies did not complete the survey in time for use in the report. These four were confirmed CAD/PAD producers but were smaller firms and believed to have had minimal impact on overall industry statistics.

Twenty-five questionnaires were returned to BIS electronically or via hard copy, representing 86 percent of U.S. CAD/PAD producing companies (29 companies). The companies represented were all domestically based; two companies were subsidiaries of foreign firms. In 1995, 58 percent (35 of 60) of the industry completed the survey and in 2000, 82 percent (27 of 33) of the industry completed the survey.

Information gathered from the survey was aggregated to protect the proprietary nature of the individual responses. The survey requested multiyear data covering total shipments, exports, employment history and labor issues, investment, and research and development (R&D). Companies also provided feedback regarding competitive prospects, mergers and acquisitions, government policies, and the effects of imports on CAD/PAD manufacturing.

Survey collection and analysis was supplemented with staff visits to facilities in Arizona and California, and with extensive contact with the individual companies via telephone and electronic mail. These interactions clarified survey responses and provided additional insight into the industry. The CAD/PAD Joint Program Office participated in this study by joining BIS representatives at on-site company visits.

### 1.3 Classification

The North American Industrial Classification System (NAICS), in addition to a contractor list provided by Indian Head, was used to determine which firms were engaged in domestic CAD/PAD production for the purposes of this study. NAICS codes replaced those of the earlier classification system, Standard Industrial Classification (SIC).

The NAICS is now the standard by which industries are classified in the United States, Canada, and Mexico. It is a production-based system that classifies goods according to particular manufacturing processes. NAICS codes are assigned at the establishment level rather than the company level to more accurately account for the manufacturing processes of each company.

U.S.-manufactured CAD/PAD products are primarily represented under two NAICS codes, Explosives Manufacturing (325920) and Motor Vehicle Air Bag Assemblies and Parts, New (336399-8534).[2] However, many survey respondents were not classified under the above two categories during the 2001-2005 period, as CAD/PADs were not the primary product produced at their establishments. Several producers made ordnance items classified as Other Ordnance and Accessories Manufacturing (332995) or Ammunition (except Small Arms) Manufacturing (332993). Other firms with strong metal working capabilities were classified under Precision Turned Product Manufacturing (332721) and Nonferrous Forgings (332112). Several firms were also listed under Guided Missile, Space Vehicle Propulsion Unit, and Propulsion Unit Parts Manufacturing (336415).

[2] North American Industrial Classification System, U.S. Census Bureau. 2002 Economic Census. Manufacturing & Mining Reference Series. NAICS Subsector 336 – Transportation Equipment Manufacturing. March 31, 2004.

## 1.4 Report Organization

This assessment begins with an overview of the domestic CAD/PAD industry in Chapter 2, covering topics including the manufacturing base and processes; major goods produced; end markets the industry supplies; and differences between defense and commercial production. Chapter 3 covers the performance of the defense and commercial sectors separately. Trends in shipments, capital investments, R&D, operating income, and employment are detailed for both sectors.

Chapter 4 explores industry competition and market prospects for companies; industry consolidation; growth and certification trends; and international trade effects. Chapter 5 examines market factors affecting the industry including government regulations; government competition with industry; the Federal Government Small Business Set-Asides and Small Business Innovation Research (SBIR) program; performance specifications; lot acceptance testing; production bottlenecks; foreign sourcing; and other pertinent issues. In the final chapter, assessment findings and proposed recommendations are presented.

# 2. Industry and Product Descriptions

## 2.1 Industry Descriptions

The CAD/PAD industry is divided into the defense and commercial sectors. Although the basic technology is common, the two sectors operate in mutually exclusive markets. Defense CAD/PADs are produced in hundreds of varieties by more than thirty companies, and contracts are predominantly driven by U.S. Department of Defense requirements.

### *2.1.1 Industry Overview*

With a broader scope and shorter production runs, defense CAD/PADs are generally produced using a more labor-intensive batch manufacturing process, while commercial CAD/PADs use continuous automated production for a narrower range of goods and long production runs. In contrast with defense CAD/PAD manufacturers, only a few companies produce the bulk of commercial CAD/PADs for automotive airbag initiators and gas generators on a large scale and in limited variety.

Workforces also reflect differences in the production order types for defense and commercial CAD/PADs. Production personnel represent over 85 percent of all employees in the commercial sector, compared with approximately 58 percent for the defense sector. Defense firms maintain a higher number of engineers on staff than do commercial firms.

The two sectors also vary in plant size and layout, skill sets, investment requirements, R&D, and profit margins (*see Table 2.1a*). Market forces in each sector also differ; the defense sector is susceptible to federal and foreign government procurement policies, and the commercial sector faces pressures from a globally integrated and highly competitive automotive industry.

| Table 2.1a: Differences Between CAD/PAD Sectors, 2001-2005 | | | | | | |
|---|---|---|---|---|---|---|
| | **Plant Size** | **Layout: Assembly Lines** | **Skill Sets: Production Workers as a % of Employees** | **Capital Investment as a % of Shipments** | **R&D as a % of Shipments** | **Pre-Tax Profits: Operating Income Margins** |
| **Defense** | Smaller | Less Automated | 58% | 1.8% | 12% | 15% |
| **Commercial** | Larger | More Automated | 86% | 3.5% | 3.4% | 9.7% |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | |

The number of firms in the industry has remained constant since the publication of the 2000 BIS CAD/PAD report. In 1990, an estimated 60 firms manufactured CAD/PAD products. By 1995, the number of participating firms was reduced to 44. As of 2000, 34 firms conducted operations across 20 different states. As reported earlier, the industry is currently comprised of 29 firms. The number of dedicated producers of commercial airbag initiators or inflators has remained relatively stable. Most of the decline in the overall number of firms in the industry stemmed from the exit of smaller defense companies.

Of the 25 firms responding to the 2005 survey, 16 were classified as small companies, six as medium sized, and three as large. These classifications were based on total annual shipments of CAD/PAD products during 2001-2005; small companies averaged less than $10 million in total annual shipments, medium companies averaged $10 million to $49 million in total shipments, and large firms averaged $50 million or higher in total shipments.

All firms included in this report were domestically based. Broken down by state, eight companies operated plants in California; three in Arizona; two each in Illinois, New Jersey, and Washington; and one plant each in Colorado, Connecticut, Florida, Maryland, Minnesota, New York, Utah, and Wisconsin.

In 2001, 88.6 percent of defense shipments came from medium and large sized companies. This declined to 78.8 percent in 2005; that year smaller firms had a 21.3 percent defense market share.

Defense shipments in 2005 averaged $3.2 million per company–a mere 1.3 percent per company of total defense shipments. Large companies averaged $20.3 million each in annual defense shipments, or 8.4 percent of total defense shipments in 2005. Medium sized firms' shipments averaged $21.8 million, or almost nine percent of total defense shipments per company.

**Table 2.1b: Number of Firms by Range of Total Defense Shipments, 2005**

| Firm Size | # Firms, 2005 | Defense Shipments | % of Defense Shipments | % of Total Shipments |
|---|---|---|---|---|
| <$10 million | 16 | $51,784,382 | 21.3% | 5.3% |
| $10 million - $49.99 million | 6 | $130,529,201 | 53.7% | 13.4% |
| ≥$50 million | 3 | $60,983,000 | 25.1% | 6.3% |

*Percentages may not total 100 percent due to rounding
**Commercial data is not provided by firm size to protect proprietary information
Source: U.S. DOC/BIS CAD/PAD Survey 2005

Large companies supplied the majority of the commercial sector shipments in 2005, capturing 97.6 percent compared to 72.9 percent of total shipments (defense and commercial combined).

Further insight is provided by analyzing which product categories are included in a firm's shipments, as well as how many categories are produced and sold by each. Companies provided both defense and commercial shipment totals for each type of product sold. Every firm that reported defense shipments for a particular product also listed commercial shipments for that same product category. Full product descriptions for these categories can be found in Appendix B.

Various types and designs of CAD/PADs are used, sometimes alone or with others to perform more complex tasks. CAD/PAD items include but are not limited to: actuators, catapults, cutters, delay initiators, detonating cords, drogue guns, fire extinguisher squibs, gas generators, impulse initiators, percussion initiated pulse cartridges, rocket motor igniters, and thrusters. The number of firms (by size) producing these items is shown in Table 2.1c.

| Table 2.1c: Defense CAD/PAD Product Production by Number and Size of Firms, 2001-2005 | | | | |
|---|---|---|---|---|
| | **Small** | **Medium** | **Large** | **Total** |
| Aircrew Escape Propulsion System | 2 | 2 | 0 | 4 |
| Electrically Initiated Impulse Cartridge | 7 | 3 | 2 | 12 |
| Percussion Initiated Impulse Cartridge | 1 | 2 | 1 | 4 |
| Initiators | 4 | 2 | 1 | 7 |
| Delay Cartridges and Delay Initiators | 6 | 3 | 1 | 10 |
| Aircraft Stores, Flares, Chaff, Sonobuoy Ejection Cartridges | 2 | 1 | 1 | 4 |
| Detonating Cords and Charges | 2 | 2 | 1 | 5 |
| Cutters | 3 | 2 | 1 | 7 |
| Catapults, Thrusters, and Removers | 3 | 1 | 1 | 5 |
| Automatic Inflators | 1 | 0 | 0 | 1 |
| Gas Generators | 3 | 2 | 1 | 6 |
| Laser Initiated Cartridges, Detonators, and Initiators | 1 | 1 | 1 | 3 |
| Rocket Motor Igniters | 5 | 1 | 2 | 8 |
| *Twenty-two firms reported shipments by CAD/PAD product category code; these are the firms represented in this table. 15 small companies; 5 medium companies; 2 large companies.<br>**Commercial figures are not included in this table due to the nature of the market. The commercial market is dominated by large companies with very little representation by small and medium sized firms.<br>Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | |

The most widely-produced CAD/PAD products were electrically initiated impulse cartridges, delay cartridges and initiators, and rocket motor igniters. Among firms that provided product-specific shipment figures, the electrically initiated impulse cartridges were produced by 46.7 percent of the small firms, 60 percent of the medium firms, and by both of the large companies.

For the 15 smaller firms that responded to this question, 42.9 percent (six firms) concentrated on one product, while 28.6 percent (four firms) produced items in two categories. Of the five medium and two large-sized respondents, only three companies reported shipments in five or more categories.

### *2.1.2 Manufacturing Process*[3]

CAD/PADs include a wide range of items for which the manufacturing processes vary. To minimize risk, all CAD/PAD devices are typically assembled first, prior to installation or loading the explosive components. For safety reasons a typical manufacturer occupies several hundred acres with specialized buildings and structures set a safe distance from public thoroughfares.

CAD/PAD production is organized into five specialized activities. These operations, arranged in sequence, are as follows:

| CAD/PAD Production Operations |
|---|
| 1. Blending and Mixing of Propellants and Explosives |
| 2. Manufacture of Metal Parts |
| 3. Subcomponent Processing and Assembly |
| 4. Cartridge Assembly |
| 5. Device or Rocket Motor Assembly |

While many firms in the industry have operations in each phase, virtually all firms subcontract portions of the work in each phase to more specialized firms. Several firms reported that metal parts were the most expensive input in CAD/PAD production. The industry practice is to outsource all or most of the fabrication of metal parts to specialized metal workers, or the customer may provide the parts. Historically, the market has been too volatile for CAD/PAD companies to carry metal parts because of their required and substantial overhead costs. Nonetheless, many CAD/PAD firms maintain a (usually small and limited) machine shop.

When manufacturing CAD/PADs, some companies leverage lean manufacturing processes to minimize labor hours with shorter set-up and clean-up times and maximize use of operational space.[4] The processes are reflective of best manufacturing practices under Six Sigma, ISO 9001, and other nationally and internationally recognized standards.

[3] U.S. DOC/BIS CAD/PAD 2000 Report

[4] Buzzell, Allie. "Lean Is Good, CAD/PAD Building 1913 Demonstration Team Discovers," January, 2005, http://www.dcmilitary.com/navy/flashpoint/2_01/features/32670-1.html.

Airbag initiator producers carry more overhead in the form of metal parts manufacturing, which is necessary to accomplish high volume production. They also use a continuous mixing process as opposed to batch production of explosives. In contrast, aerospace CAD/PADs are normally built in lots or batches using explosive or propellant charges mixed in a single batch and (frequently outsourced) precision machined metal parts.

Most CAD/PAD companies blend and mix propellants and explosives. This is done by adding measured amounts of chemical ingredients into a mixer and then blending and curing the ingredients at controlled temperatures for specific time periods. Further processing in the form of machining or cutting may also be required to get the material into proper form. These energetic materials may then be incorporated into the CADs or PADs as a "dry load" in the form of pellets, particles, or powders of predetermined size, as a "wet load" (i.e., viscous fluid), or as a pliable semi-solid, which hardens when cured.

Cartridge manufacture begins with the precision machining of metal parts. These parts are cleaned prior to assembly to remove residual oils and particles, which can adversely affect the performance of explosives and propellants. If the device is to be electrically initiated, the cartridge goes through a glass-to-metal sealing process that seals one end of the cartridge while allowing electrical contact pins to protrude through the seal. This glass seal provides a critical barrier to the ballistic pressure that will occur during firing so it can be channeled to do work. The pins provide the means of connecting the cartridge to the firing circuit.

An electric bridge wire is soldered or welded to the pins inside the case. The bridge wire will eventually be in contact with the primary explosive material. Current through the bridge wire will provide the heat source for igniting the primary explosive. In some cases, the cartridge is percussion primed. The primer is pressed into the primer pocket, which, when struck, will provide the heat source for igniting the primary charge, in place of the bridge wire. An epoxy sealant is used with percussion primers and a glass-to-metal seal is used around the connecting pins.

Each explosive charge (usually several per cartridge) is precisely weighed and segregated. Then, each charge is loaded in each cartridge case of the lot. Some charges such as fine powders are pressed into place during loading. The primary charge (i.e., the most sensitive charge) is loaded next to the primer or bridge wire, and then the secondary charge is loaded according to precise measurements. When the charges are loaded, a closure is placed over the cartridge opening. The closure is usually a thin metal disk that is stitch or laser-welded to the case, or sometimes held by crimping the case over a seal and the disk; sometimes epoxy is also used to ensure sealing at this end.

*Propellants* and *explosives* are chemical compounds or mixtures of compounds that rapidly produce large volumes of hot gases when ignited. Propellants burn at relatively slow rates measured in centimeters per second. Explosives detonate at rates measured in kilometers per second. Pyrotechnic materials evolve large amounts of heat but much less gas than propellants or explosives. *Deflagration* (burning) occurs when the released gases expand at velocities less than the speed of sound (about 1,100 ft/sec. in air at normal temperatures). *Detonation* is the term used to describe expanding velocities greater than the speed of sound.

A key advantage of these energetic materials is the relatively large amounts of energy stored compactly and readily available to perform a variety of work functions. Propellants are used when the energy required is released in milliseconds (in guns or airbags) or up to seconds (in rockets). Propellants are used for moving pistons, shearing bolts and cable, releasing bombs from bomb racks, and starting engines. Explosives are used when energy requirements are instantaneous and of short duration, and more energetic. These include severing panels and fracturing aircraft canopies.

## 2.2 Major Products, End Markets, and Process[5]

CAD/PADs are used in many modern weapons systems. The cartridges use precisely measured propellant and explosive mixtures of varying compositions and burning characteristics to perform a wide variety of jobs critical to safety, survivability, and weapon system performance.

[5] U.S. DOC/BIS CAD/PAD 2000 Report

### *2.2.1 CAD/PAD Products*

More than 3,100 part numbers are in use by the U.S. military, and within the Navy and Marine Corps alone; CAD/PADs generate up to 90,000 supply and maintenance transactions per year.[6] The devices range in cost from about $1 to over $10,000 each, and may be purchased one at a time or by the thousands. The products have a limited shelf life and must be periodically replaced or changed out to maintain effectiveness and safety considerations.

CAD/PADs can break a seal to release fire extinguisher contents, ignite a detonation cord for mining explosions, release a satellite from a launch vehicle, and assist with parachute deployment. They are also instrumental in ejecting flares and chaff from aircraft as countermeasures against incoming heat-seeking or radar-guided missiles; cutting helicopter cargo cables in airdrop re-supply; providing staging operations for unmanned aerial vehicles; and rapidly inflating military aquatic rafts.

With several exceptions, device assembly is normally outside the purview of most CAD/PAD producers. The device manufacturers, however, usually work closely with the CAD/PAD producers to ensure the product is properly engineered. In some operations, device makers have even integrated the CAD/PAD producer into their vertical structure.

Sometimes devices are made or assembled as an integral part of the cartridge by the CAD/PAD producer. These can include cable cutters, detonating cord, and valves. Other device assembly, such as bomb racks or ejection seats, is conducted by the military or prime contractors, and often may be one of the last steps completed before intended use. See Appendix B for additional product descriptions and illustrations.

As already noted, over time the number and sophistication of CAD/PAD devices used in air vehicles has increased. This trend appears to be continuing both as new applications are developed and market outlets, such as the space program, continue to expand. The use of initiators and inflators in motor vehicles is also expanding both in the number of vehicles using

[6] Williams, Dave, Dale Thomas, and Tony Taylor. "Virtual Fleet Support for the CAD/PAD: A Business Re-engineering Success Story," *Defense AT&L Magazine,* May-June, 2005, p.47.

airbags and the number of airbags per vehicle. The technology these items utilize was derived directly from the CAD/PAD defense sector.

# 3. Industry Performance, 2001-2005

This section reviews the statistical trends for the U.S. CAD/PAD industry from 2001 to 2005. The defense and commercial sectors are treated separately. Shipments, exports, investment in new plant and equipment, research and development, and profitability are reviewed for both sectors.

## 3.1 Defense CAD/PAD Sector

The defense CAD/PAD sector as a whole grew over the 2001-2005 period, with some categories showing higher growth rates than others. Defense spending for the conflicts in Iraq and Afghanistan have provided strong sales increases for CAD/PAD consumables. Ejection seat-related CAD/PAD products remained steady over the five year period, and will see slower or negative growth in the future as older aircraft are retired and replaced with fewer new systems. Overall, the future appears promising as defense spending for systems incorporating CAD/PADs is likely to increase moderately over the next several years.

### *3.1.1 Defense Shipments*

Defense shipments for the 25 firms that responded to the survey experienced a sizable increase from $203.6 million to $243.3 million from 2001-2005. The five-year growth in the sector was 18.2 percent, averaging approximately 4.6 percent per year (*see Table 3.1a*). When compared to growth data during the same period for similar industries like automotive (11.1 percent), mining (16.4 percent), and small arms ammunition (10.5 percent), the CAD/PAD industry demonstrates a strong, sustained growth trend. Any commercial shipments by defense-predominant companies were included in commercial shipment data (*see Section 3.2 below*). Based on survey responses, the defense sector applications included ground, aerospace, and naval uses.

| Table 3.1a: Defense CAD/PAD Shipments 2001-2005 (in $ 000's) | | | | | | |
|---|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **2005** | **5-Yr Avg** |
| **Shipments** | 203,597 | 214,433 | 224,074 | 228,805 | 243,297 | 222,842 |
| **% change** | - | 5.3 | 4.5 | 2.1 | 6.3 | 4.6 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | |

*3.1.1.1 Defense Shipments, by Type*

Table 3.1b breaks out CAD/PAD shipments by the 13 product categories over the 2003-2005 period. Electrically Initiated Impulse Cartridges ($60 million or 26 percent) and Aircrew Escape Propulsion System components ($42 million or 18 percent) were the two dominant product categories. Detonating Cords, Gas Generators, Aircraft Stores, and Rocket Motor Igniters also had shipments of more than $10 million over the five year period.

| Table 3.1b: Defense CAD/PAD Shipments by Item, 2003-2005 (in $ 000's) | | | | | |
|---|---|---|---|---|---|
| | **2003** | **2004** | **2005** | **3-Yr Growth, 03/01** | **3-Yr Avg** |
| Aircrew Escape Propulsion Systems | 41,796 | 38,733 | 41,620 | -0.42% | 40,716 |
| Electrically Initiated Impulse Cartridges | 51,008 | 57,900 | 60,033 | 17.69% | 56,314 |
| Percussion Initiated Impulse Cartridges | 4,731 | 4,501 | 4,218 | -10.84% | 4,483 |
| Initiators (Impulse) | 7,887 | 7,314 | 9,316 | 18.12% | 8,172 |
| Delay Cartridges and Initiators | 9,267 | 11,341 | 8,573 | -7.49% | 9,727 |
| Aircraft Stores, Flares, Chaff, Sonobuoy Ejection Cartridges | 14,693 | 19,325 | 21,659 | 47.41% | 18,559 |
| Detonating Cords and Charges | 33,862 | 29,951 | 30,584 | -9.68% | 31,466 |
| Cutters | 3,917 | 2,394 | 4,066 | 3.80% | 3,459 |
| Catapults, Thrusters, Removers | 3,544 | 1,685 | 2,949 | -16.79% | 2,726 |
| Automatic Inflators | 1,308 | 3,463 | 3,156 | 141.28% | 2,642 |
| Gas Generators | 15,939 | 17,693 | 17,897 | 12.28% | 17,176 |
| Laser Initiated Cartridges, Detonators, and Initiators | 14,546 | 13,018 | 14,944 | 2.74% | 14,169 |
| Rocket Motor Igniters | 16,073 | 13,834 | 13,880 | -13.64% | 14,596 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | |

Shipments grew over the three-year period from 2003 to 2005 for seven of the 13 product categories. Five of these experienced growth of over 10 percent, with shipments of Automatic Inflators growing over 141 percent. The other categories included Aircraft Stores, Flares, Chaff, Sonobuoy Ejection Cartridges (47.4 percent), Impulse Initiators (18.1 percent), Electrically Initiated Impulse Cartridges (17.7 percent), and Gas Generators (12.3 percent). The remaining two product lines grew by just under four percent (Cutters 3.8 percent and Laser Initiated Cartridges, Detonators, and Initiators 2.7 percent).

Six of the 13 product categories experienced declining shipments over this period, with one category shrinking nearly 17 percent (Catapults, Thrusters, and Removers). Rocket Motor Igniters and Percussion Initiated Impulse Cartridges also declined by more than ten percent (13.6 percent and 10.8 percent respectively). Two other product lines experienced declining shipments between five and ten percent, with the remaining product line remaining most constant with a decline of under half of a percent (Aircrew Escape Propulsion Systems). Table 3.1c provides a breakout of the number of product manufacturers and the percent of total shipments for each product line.

**Table 3.1c: Number of Companies and Shipments of Military Related CAD/PADs 2005 (in $000s)**

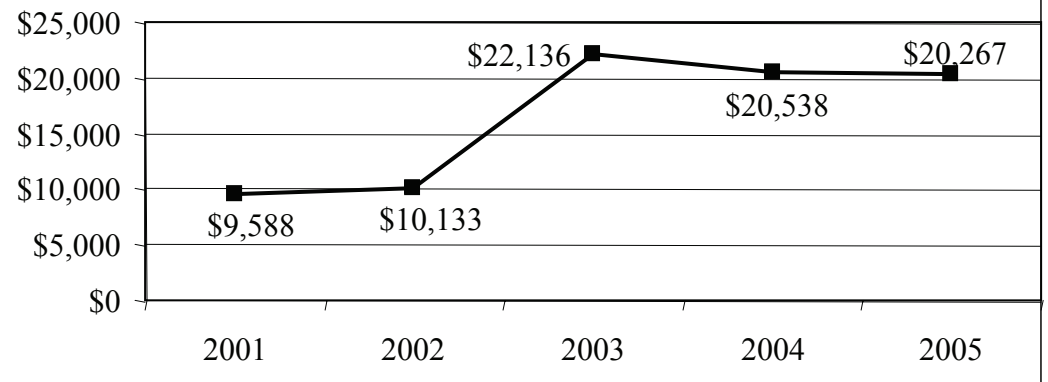
| CAD/PAD Products for Defense* | # of Shippers | Shipments ($000s) | Percent of Total Shipments |
|---|---|---|---|
| Aircrew Escape Propulsion System | 3 | $41,620 | 17.9% |
| Electrically Initiated Impulse Cartridge | 12 | $60,033 | 25.8% |
| Percussion Initiated Impulse Cartridge | 4 | $4,218 | 1.8% |
| Initiators (Impulse) | 5 | $9,316 | 4.0% |
| Delay Cartridges and Delay Initiators | 9 | $8,573 | 3.7% |
| Aircraft Stores, Flares, Chaff, Sonobouy Ejection Cartridges | 4 | $21,659 | 9.3% |
| Detonating Cords And Charges | 4 | $30,584 | 13.1% |
| Cutters | 5 | $4,067 | 1.7% |
| Catapults, Thrusters, Removers | 4 | $2,949 | 1.3% |
| Gas Generators | 6 | $17,897 | 7.7% |
| Rocket Motor Igniters | 8 | $13,881 | 6.0% |

*Totals for Automatic Inflators and Laser Initiated Cartridges, Detonators, and Initiators are not shown to protect proprietary information. The percent of total shipments summed therefore does not equal 100 percent.
Source: U.S. DOC/BIS CAD/PAD Survey 2005

*3.1.1.2 Defense Exports*

Eight companies reported total defense exports of $82.7 million over the 2001-2005 period (*see Figure 3.1a*). Exports accounted for approximately 7.4 percent of all U.S. CAD/PAD shipments in the 2001-2005 timeframe. Many companies reported that they had no export program at all and relied solely on domestic business for all sales. Although exports were generally not a major component of overall shipments, there was a significant increase of consumable CAD/PAD items during 2003, possibly associated with U.S. military operations in Iraq and Afghanistan. Two large defense CAD/PAD companies directed $12.3 million of shipments overseas in 2003. However, this export increase was not matched in subsequent years.

Figure 3.1a: Defense Exports, 2001-2005 in $000's




Source: U.S. DOC/BIS CAD/PAD Survey 2005

Items most commonly exported included Electrically Initiated Impulse Cartridges ($6.8 million, 8 percent of total), Delay Cartridges ($4.2 million, 5 percent of total), and Detonating Cord and Charges ($10.1 million, 12 percent of total). As a minor percentage of overall shipments, and in such a limited number of product lines, exports are not a prominent revenue generator for the U.S. defense CAD/PAD sector. No survey respondents indicated a dependence on exports. However, some firms expressed an interest in standardizing procedures by which U.S. CAD/PAD commodities are shipped to international destinations. One company indicated a desire to have former military products reclassified as commercial to expedite the export process (*see Section 5.1.3 for discussion of export controls*).

### *3.1.2 Defense Sector Investment in New Plant, Machinery, and Equipment*

Capital outlays on new plant and equipment by the defense CAD/PAD sector totaled $19.7 million during the 2001-2005 period. Investment in new facilities comprised $3.7 million, while $16.0 million was invested in new machinery and equipment. Though the yearly average for plant investment totaled approximately $745,000, a spike in 2004 boosted the five-year annual average. That year, a one-time capital expense was reported on plans to improve productivity, and the unique resource use caused defense sector outlays to significantly jump from 2003. However, this anomaly was not indicative of average capital spending on plant needs. Similarly, investment in new machinery and equipment in 2004 was one and a half times that of the year before and remained above $3.5 million in 2005.

**Table 3.1d: Defense Investments by Category, 2001-2005 (in $000s)**

| | 2001 | 2002 | 2003 | 2004 | 2005 | Average |
|---|---|---|---|---|---|---|
| **Plant** | 241 | 306 | 173 | 2224 | 784 | 746 |
| **Machinery and Equipment** | 3,422 | 2,685 | 2,532 | 3,846 | 3,540 | 3,205 |

Source: DOC/BIS CAD/PAD Survey 2005

The defense sector's capital investment for the 2001-2005 period was less than half that of the 1995-1999 period. Overall, plant investment accounted for approximately 19 percent of all investment outlays. This is significantly lower than during the 1995-1999 period when plant investment accounted for one-third of investment. Machinery and equipment investment, though a larger percentage of overall investment when compared to the 1995-1999 period, was just over half of the dollar value of machinery and equipment for the earlier period ($1 million versus $30 million).

Survey respondents were asked to identify and rank their investment strategies based on the last three years of investment experience. Eighteen defense companies surveyed replied to the questions. Firms were asked to respond to seven investment strategies and rank them from one to seven by order of importance (1 = Most Important; 7= Least Important.) Investment rankings

were balanced across all the responses to derive an industry rank from 1 to 7. Rankings for the current period and that of the 2000 report are shown in Table 3.1e.

| Table 3.1e: Strategies for New Investment | Comparative Rankings | |
|---|---|---|
| | 2000 | 2005 |
| 1. Replace Poor or Non-Functioning Equipment | 5 | 2 |
| 2. Improve Productivity | 1 | 4 |
| 3. Expand Capacity | 4 | 7 |
| 4. Add New Capability | 3 | 5 |
| 5. Upgrade Technology | 2 | 6 |
| 6. Meet Specific Customer's Requirements | 7 | 3 |
| 7. Comply with Environmental/Safety Requirements | 6 | 1 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2000, 2005 | | |

Complying with environmental and safety requirements went from second to last in priority in 2000 to topping the list of motivations for investment in 2005. Similarly, meeting specific customer requirements and replacing poor or non-functioning equipment became more important when considering investment options. Productivity improvements, upgrading technology, and adding new capabilities dropped out of the top three and expanding capacity dropped to bottom rank.

Of the 18 respondents to the investment question, 12 were classified as “small” companies. Six were classified as “medium” and “large”. A breakout of responses is shown in Table 3.1f.

| Table 3.1f: Strategies for New Investment | Comparative Rankings | | |
|---|---|---|---|
| | Small | Medium | Large |
| 1. Replace Poor or Non-Functioning Equipment | 3 | 1 | 4 |
| 2. Improve Productivity | 4 | 4 | 3 |
| 3. Expand Capacity | 7 | 2 | 5 |
| 4. Add New Capability | 5 | 5 | 1 |
| 5. Upgrade Technology | 6 | 6 | 2 |
| 6. Meet Specific Customer's Requirements | 1 | 7 | 6 |
| 7. Comply with Environmental/Safety Requirements | 2 | 3 | 7 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | |

For small firms, which comprise the majority of U.S. CAD/PAD producers, meeting the specific requirements of the customer is critical, something ranked much lower by the medium and large companies. There is little or no emphasis on investing to add new capabilities, expand existing capacity, or upgrade technology for these small firms. As with many small businesses, these CAD/PAD producers seem to view stability as the primary investment goal of the company.

Medium-sized companies, on the other hand, are interested in replacing poor or nonfunctioning equipment and expanding capacity. Like small companies, they are concerned about complying with environmental and safety requirements. Large companies are meanwhile least concerned with these requirements and focus on the importance of adding new capabilities, upgrading technology, and improving productivity.

### *3.1.3 Defense Research and Development*

Defense research and development funding came primarily from the private sector through in-house funding, averaging just over 95 percent from 2001 to 2005 (*see Table 3.1g)*. U.S. Government funding averaged 2.5 percent, though for three of the five years, funding was over three percent and reached a high of 4.3 percent in 2005.

**Table 3.1g: Sources of Defense R&D Funding, in percentage**

| Source | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|
| USG | 3.7 | 3.3 | 0.9 | 0.4 | 4.3 |
| Private | 96.3 | 96.7 | 97.6 | 93.6 | 92.7 |
| Foreign | 0.0 | 0.0 | 1.5 | 6.0 | 3.0 |

Source: U.S. DOC/BIS CAD/PAD Survey 2005

R&D spending in the defense CAD/PAD sector totaled $132.6 million, including a five-year peak of $43 million in 2003 (*see Table 3.1h*). Spending in 2005 was up 177 percent from $12.4 million in 2001. During 2001-2005, defense companies spent an additional $54 million non-defense R&D – a relatively high number compared to the 1995-1999 period.

| Table 3.1h: R&D Spending in the Defense CAD/PAD Sector, 2001-2005 (in $ 000's) | | | | | | |
|---|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **2005** | **Total** |
| **Defense R&D Spending** | $12,366 | $7,921 | $43,019 | $35,048 | $34,248 | $132,602 |
| **% change** | n/a | -35.9% | 443.1% | -18.5% | -2.3% | 176.9% |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | |

In light of the low levels of capital investment and profitability among the smaller companies, this was a surprising finding; it might have been expected that these smaller producers would have little or no R&D. Also notable was the fact that defense CAD/PAD companies outspent their commercial counterparts in R&D by over 40 percent. The increase during this period was attributed to large sums invested in R&D by a few of the larger companies. This investment in R&D in the defense CAD/PAD sector represents a change within the industry, and a very positive development for long-term growth.

The defense sector allocated an average of 51 percent of all R&D spending to product development, 12 percent on materials and 37 percent on production processing over the 2001-2005 period.

| Table 3.1i: Defense R&D Spending by Category, 2001-2005 | | | | | | |
|---|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **2005** | **Average** |
| **Materials** | 7.8% | 11.0% | 10.6% | 14.7% | 12.2% | 12.1% |
| **Production Processing** | 60.7% | 43.1% | 45.4% | 25.3% | 33.8% | 37.1% |
| **Product Development** | 31.6% | 45.9% | 44.0% | 60.0% | 53.9% | 50.8% |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | |

*3.1.3.1 Defense R&D Spending as a Percentage of Shipments*

| Table 3.1j: Defense R&D Spending as a Percentage of Shipments, 2001-2005 | | | | | | |
|---|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **2005** | **5-Yr Average** |
| **R&D Spending as a % of Shipments** | 6.1% | 3.7% | 19.2% | 15.3% | 14.1% | 11.9% |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | |

Defense R&D expenditures amounted to 14.1 percent of defense shipments in 2005, down from a five-year high of 19.2 percent in 2003 (*see Table 3.1j*). R&D spending as a percentage of shipments for defense remained at the relatively low levels recorded in 1999 through the first two years of this study. In 2003, however, this ratio increased sharply to 19.2 percent, and has since remained at levels more than three times those recorded at the end of the period covered by the 2000 report.

*3.1.3.2 Defense R&D Spending Per Employee*

R&D spending per employee in the defense sector reached $17,271 in 2005, up 149 percent from $6,939 in 2001; the five-year average was $14,416 per year. Defense R&D has also increased markedly since the 2000 report. Per-employee R&D spending increased over 125 percent from 1999 to 2005.

With spending per worker increasing and relatively stable employment levels, defense companies, even the smaller firms, are making a substantial investment in future technologies, improvement in physical plant, processes, and next-generation product development. Companies in this sector recognize the need to increase employee productivity by instituting new practices that will enhance efficiency, and make other infrastructural changes that will lead to long-term success in the market.

### *3.1.4 Defense Operating Income*

The ten companies responding to the survey reported operating income from defense shipments of $39.2 million in 2005, up 80.9 percent from $21.7 million in 2001 (*see Table 3.1k*). The 2001 figure is down 17.8 percent from 1999, when operating income reached $26.4 million. It is interesting to note that between 2002 and 2003, operating income rose 94.1 percent while shipments only rose 4.5 percent.

**Table 3.1k: Operating Income in the Defense CAD/PAD Sector, 2001-2005 (in $ 000's)**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 5-Yr Avg | CAGR |
|---|---|---|---|---|---|---|---|
| **Operating Income** | 21,675 | 21,346 | 41,439 | 42,766 | 39,214 | 33,288 | |
| **% Change** | n/a | -1.5% | 94.1% | 3.2% | -8.3% | 16.2% | 12.6% |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | | |

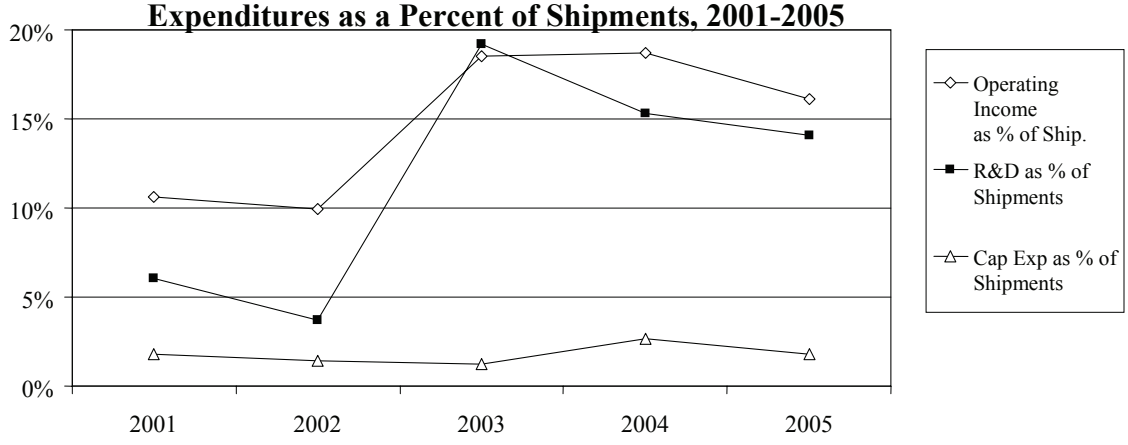
Operating income reached 10.6 percent in 2001, almost equaling the 1999 figure of 10.7 percent. The current period highlighted steady growth through 2004, when it peaked at 18.7 percent, then slightly declined to 16.1 percent in 2005 (*see Table 3.1l*). In contrast, 1995-1998 operating income hovered between 8.1 percent and 8.8 percent before rising in 1999.

**Table 3.1l: Defense Operating Income as a Percentage of Shipments, 2001-2005 (in $ 000's)**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 5-Yr Avg |
|---|---|---|---|---|---|---|
| **Income as a Percent of Shipments** | 10.6% | 10.0% | 18.5% | 18.7% | 16.1% | 14.9% |
| **% Change** | n/a | -6.5% | 85.8% | 1.1% | -13.8% | 10.4% |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | |

Higher operating income margins during 2001-2005 indicate improved cost containment efforts, compared to the 1995-1999 period. When comparing operating income to R&D expenditures and capital expenditures as a percentage of shipments over the past five years, pre-tax income margins outpaced each of these cost categories on an annual basis, with the exception of 2003. In 2003, R&D spending topped operating income 19.2 percent to 18.5 percent. Based on the data in Figure 3.1.b, R&D expenditures with attentive capital cost management practices are helping to drive up pre-tax income levels.

**Figure 3.1.b: Defense Operating Income, R&D, and Capital Expenditures as a Percent of Shipments, 2001-2005**




Source: U.S. DOC/BIS CAD/PAD Survey 2005

### *3.1.5 Defense Employment*

Total employment in the defense CAD/PAD sector increased 11.3 percent over the 2001-2005 period from 1,782 in 2001 to 1,983 workers in 2005. However, total employment in the defense sector has decreased more than 13 percent since 1999 and two percent since 1995. Mergers and acquisitions, job attrition and retirements have all contributed to a slight decrease in overall defense employment in the industry since 1995.

#### *3.1.5.1 Defense Production Workers*

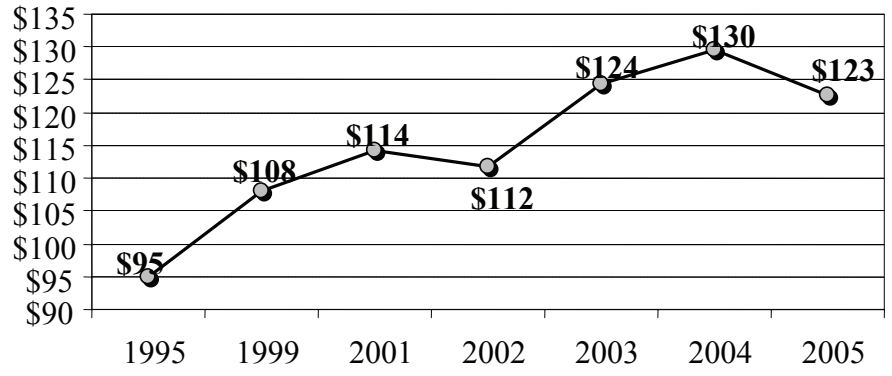
Defense production workers increased 12 percent from 1,057 to 1,184 during 2001 to 2005. As a proportion of total employees, production workers averaged approximately 60 percent of defense CAD/PAD employment in 2005. The ratio of production workers to non-production workers has increased slightly since 1995, rising from 55 to 60 percent; non-production workers fell from 44 percent to 40 percent over the same period (*see Table 3.1m*).

| Table 3.1m: Number of Defense CAD/PAD Employees, 1995-2005 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1995** | **1999** | | **2001** | **2002** | **2003** | **2004** | **2005** |
| **Production Employees** | 1,129 | 1,263 | | 1,057 | 1,134 | 1,057 | 1,013 | 1,184 |
| % of Production Workers | 55.8% | 55.1% | | 59.3% | 59.1% | 58.7% | 57.4% | 59.7% |
| **Non-Production Employees** | 893 | 1,028 | | 725 | 786 | 743 | 753 | 799 |
| % of Non-Production Workers | 44.2% | 44.9% | | 40.7% | 40.9% | 41.3% | 42.6% | 40.3% |
| **Total Defense Employment** | **2,022** | **2,291** | | **1,782** | **1,920** | **1,800** | **1,766** | **1,983** |
| Source: U.S. DOC/BIS CAD/PAD Surveys 1995, 1999, and 2005 | | | | | | | | |

*3.1.5.2 Defense Productivity per Employee*

Productivity (measured in defense shipments per employee) rose slightly during the 2001-2005 time period. Overall, shipments per employee grew at a 7.4 percent change during 2001-2005 compared with 13.8 percent over the 1995-1999 period. Shipments per employee increased from about $95,000 in 1995 to nearly $123,000 in 2005. The low for the 2001-2005 period was in 2002 when shipments fell to $111,684 per employee (*see Figure 3.1c*).

**Figure 3.1c: Defense CAD/PAD Shipments per Employee 1995-2005 (in $ 000's)**




Source: U.S. DOC/BIS CAD/PAD Survey 2005

## 3.2 Financial Indicators for the Defense CAD/PAD Sector

### *3.2.1 Operating Profits*

Thirteen defense CAD/PAD companies reported an average annual growth rate of 11.4 percent in operating profit during 2001-2005. Operating profit climbed from $18.5 million in 2001 to a

high of $30.6 million in 2003 before dropping approximately 23 percent to $23.5 million in 2005 (*see Table 3.2a*). The compound annual growth rate (CAGR) was 4.9 percent. CAGR is the year-on-year growth rate applied to an investment or other part of a company's activities over a multiple-year period.

**Table 3.2a: Operating Profits for Defense CAD/PAD Industry 2001-2005 (in $000's)**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 5-Yr Avg | CAGR |
|---|---|---|---|---|---|---|---|
| **Operating Profits** | $18,459 | $17,628 | $30,598 | $30,290 | $23,452 | $18,459 | 4.9% |
| **Year-on-Year Growth** | | -4.5% | 73.6% | -1.0% | -22.6% | 11.4% | |

Source: U.S. DOC/BIS CAD/PAD Survey 2005

### *3.2.2 Current Ratio*

The current ratio provides an indication of a firm's ability to cover short-term debt obligations. The ratio is a useful assessment of company financial strength, calculated by dividing current assets attributed to CAD/PAD operations by current liabilities. Eight of 25 firms responded, reporting an average current ratio of 4.04 over the five-year period. This figure indicates that over the 2001-2005 period, firms had over four times more current assets than current liabilities, suggesting that respondents comfortably met short-term debt obligations over the time period.

Often, a higher ratio signifies a healthy financial situation for a company and industry. However, the ratio may be heavily influenced by inventories, which can inflate current assets if in-process production, testing or other delays slow shipments of finished products. Thus, in some cases, a high ratio can indicate production inefficiency. For this reason, the quick ratio can be used to test for liquidity by isolating only easily convertible assets such as cash.

### *3.2.3 Quick Ratio*

The nine reporting firms for the defense CAD/PAD sector had an average quick ratio of 1.90 from 2001 to 2005. This ratio, calculated by dividing current assets less inventory by current liabilities, indicates that there are 1.90 dollars of easily convertible assets for every dollar of

current liabilities. In general, a quick ratio of over one is considered acceptable by most creditors; however, this can vary across industries. The defense CAD/PAD sector may be more inclined to have larger volumes of inventory on-hand to support the defense industrial base in case of a military emergency.

### *3.2.4 Total Asset Turnover Ratio*

The asset turnover ratio measures how much a firm earns in shipments for each $1 in inventory. Nine of the 25 survey respondents provided the data to calculate this ratio. Their average asset turnover ratio was 0.9 during the five-year period. This figure roughly indicates a sector's or industry's efficiency in producing and selling its goods. A higher number represents a more capital intensive industry. The straight average was 1.13 for the 2001-2002 and 0.74 for 2003-2005. The lower straight averages indicate that larger firms are less capital intensive on a shipments-to-asset basis than smaller firms.

## 3.3 Commercial End-Uses

The commercial CAD/PAD market has grown tremendously over the past fifteen years. Increased global demand and changes in U.S. regulations requiring different types of airbags for newly manufactured automobiles and light trucks have contributed significantly to market expansion in this sector. In times of increasing pressures on automakers to lower costs with each new contract, commercial CAD/PAD companies have incorporated continuous improvement methods to maximize profit margins.

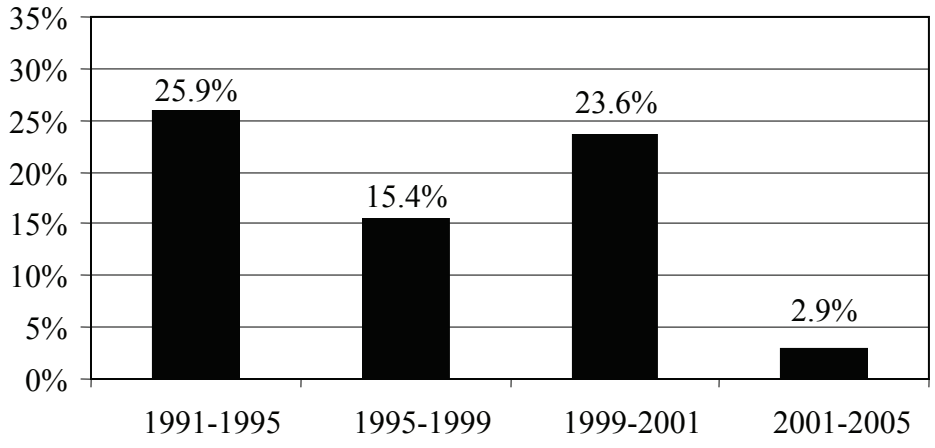
### *3.3.1 Commercial Shipments*

Shipments of airbag initiators and gas generators grew at a 2.9 percent compound annual growth rate (CAGR) from 2001 to 2005 (*see Table 3.3a*). This CAGR is significantly lower than the 2000 and 1995 reports when the industry experienced 15.4 percent and 25.9 percent of compound annual growth, respectively. Industry shipments almost doubled from $334.4 million in 1999 to $630.7 million in 2001.

| Table 3.3a: Commercial CAD/PAD Shipments of Airbag Initiators and Gas Generators, 2001-2005 (in $ 000's) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **2005** | **5-Yr Avg** | **CAGR** |
| **Shipments** | 630,708 | 664,741 | 665,906 | 767,314 | 726,264 | 690,987 | n/a |
| **% Change** | n/a | 5.4% | 0.2% | 15.2% | -5.3% | 15.2%* | 2.9% |
| * % change from 2001 to 2005<br>Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | | |

As reported in the 2000 BIS CAD/PAD study, commercial shipments grew 105 percent from $163.5 million in 1995 to $334.4 million in 1999, the last year that data was collected for the 2000 report. From 2001 to 2005, shipments grew more than 15 percent to $726.2 million.[7] Commercial CAD/PAD industry shipments grew by 344 percent between 1995 and 2005. Figure 3.3a illustrates shipments growth rates for the time periods outlined above.

**Figure 3.3a: Commercial CAD/PAD Shipments, Compound Annual Growth Rates, 1991-2005**




Source: DOC/BIS CAD/PAD Survey 2005

[7] Complete commercial figures can be found in Appendix E.

*3.3.1.1 Commercial: Exports*

Gas generators accounted for more than 95 percent of all commercial CAD/PAD exports in 2005. From 2001-2005, commercial exports grew at a 7.2 percent compound annual growth rate and a 41.5 percent from the beginning of the five-year period to the end. Export levels increased every year through 2004, but shrank by 11.1 percent in 2005 (*see Table 3.3b*).

**Table 3.3b: Automotive CAD/PAD Exports, 2001-2005**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 5-Yr Avg | CAGR |
|---|---|---|---|---|---|---|---|
| **Exports ($000s)** | 155,068 | 177,467 | 206,242 | 246,933 | 219,405 | 201,023 | n/a |
| **% Change** | n/a | 14.4% | 16.2% | 19.7% | -11.1% | 41.5%* | 7.2% |
| **Exports as a % of Shipments** | 24.6% | 26.7% | 31.0% | 32.2% | 30.2% | 29.1% | n/a |

* % change from 2001 to 2005
Source: U.S. DOC/BIS CAD/PAD Survey 2005

*3.3.1.2 Commercial: Positive Impact of Federal Government Regulations*

U.S. Government regulations regarding the use of airbags in automobiles have led to increased commercial CAD/PAD shipments. The 1991 Intermodal Surface Transportation Efficiency Act mandated the use of dual airbags in all new passenger cars manufactured beginning in 1998 and all new light trucks manufactured beginning in 1999.[8]

The National Highway Traffic Safety Administration (NHTSA) instituted a rule in 2004 which launches a 3-year phase-in of incorporating side airbags in 20 percent of new automobile manufacturing beginning in 2009 and 100 percent of all new U.S. manufactured automobiles and light trucks by 2011.[9] The 2004 NHTSA rule will likely increase commercial CAD/PAD shipments dramatically over the next five years.

[8] U.S. Department of Transportation, "Intermodal Surface Transportation Efficiency Act of 1991," Section 208.
[9] U.S. Department of Transportation, National Highway Traffic Safety Administration, 49 CFR Parts 571 and 598, [Docket No. NHTSA-2004-17694], RIN 2127—AJ10, Federal Motor Vehicle Safety, Standards; Side Impact Protection; Side Impact Phase-In Reporting Requirement, X. Proposed Lead Time and Phase In.

*3.3.2 Commercial: Investments in New Plants, Machinery, and Equipment*

During the 2001-2005 period, capital expenditures in commercial CAD/PAD manufacturing for plant, machinery and equipment totaled over $132 million, falling 33.2 percent from $27.5 million in 2001 to $18.4 million in 2005.[10] Capital expenditures in 2005 were slightly higher than the 2000 and 1995 reports, when expenditures were $16.6 million and $17.8 million, respectively.

As a percentage of shipments value, commercial sector capital expenditures fell to 2.5 percent in 2005 from 4.4 percent in 2001. For comparison, companies reported 4.9 percent of shipments value attributed to capital expenditures in the 2000 report and 10.9 percent in the 1995 report.

On a per employee basis, capital expenditures totaled $8,418 per employee in 2005, down 43.6 percent from $14,925 in 2001-2005. The five-year average was $10,391 per year, down 57.4 percent from an average of $24,386 per year for the 2000 report.[11]

Survey respondents ranked the business decisions concerning commercial CAD/PAD capital expenditures in the following order of importance: add new capability, meet specific customer requirements, upgrade technology and improve productivity, expand capacity, improve environmental safety compliance, and replace non-functioning or poorly functioning equipment. Over the next five years capital expenditures are expected to rise to meet the growing demand for side airbags mandated by the U.S. Government.

### *3.3.3 Commercial Research and Development*

Research and development spending in the commercial CAD/PAD sector totaled $37.8 million in 2005, up 36.2 percent from $27.7 million in 2001. During 2001-2005, R&D spending peaked at $40.2 million in 2004 (*see Table 3.3d*). This sector allocated approximately 71 percent of all

[10] Dollar figures for the period could not be provided to maintain business confidentiality.
[11] The 1995 Assessment of the CAD/PAD Industry did not break out commercial from defense capital expenditures. Hence, a 5-year average of capital expenditures per employee during 1991-1995 could not be calculated.

R&D spending to product development, 23 percent on materials and 6 percent on production processing.

| Table 3.3c: Commercial R&D Spending by Category, 2001-2005 | | | | | | |
|---|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **2005** | **5-Yr Average** |
| **Product Development** | 73.4% | 76.5% | 76.4% | 63.5% | 70.0% | 71.0% |
| **Materials** | 23.4% | 21.7% | 21.8% | 27.7% | 19.5% | 23.0% |
| **Production Processing** | 3.2% | 1.8% | 1.8% | 8.8% | 10.5% | 6.0% |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | |

The commercial sector's R&D spending figures are significantly higher than the data reported in the previous two CAD/PAD studies and likely reflect the industry's highly competitive environment and the need to meet the side airbag requirements being phased in over the next few years. The sector reported $6.4 million in R&D spending in the 2000 report and $5.5 million in 1995. From 1991 to 1999 (the beginning and end years reported in the 1995 and 2000 studies, respectively), R&D spending in this sector peaked at $18.7 million in 1998.

| Table 3.3d: R&D Spending in the Commercial CAD/PAD Sector, 2001-2005 (in $ 000's) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **2005** | **5-Yr Avg** | **CAGR** |
| **Commercial R&D Spending** | 27,725 | 28,031 | 36,276 | 40,235 | 37,748 | 34,003 | n/a |
| **% Change** | n/a | 1.1% | 29.4% | 10.9% | -6.2% | 36.2%* | 6.4% |
| * % change from 2001 to 2005<br>Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | | |

| Table 3.3e: Sources of Commercial R&D Funding (Percent) | | | | | |
|---|---|---|---|---|---|
| **Source** | **2001** | **2002** | **2003** | **2004** | **2005** |
| USG | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Private | 83.5 | 99.5 | 100.0 | 99.0 | 100.0 |
| Foreign | 16.5 | 0.5 | 0.0 | 1.0 | 0.0 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | |

For this study, nearly all of commercial sector R&D was reported as in-house/self-funded for 2001-2005. The remaining funding was reported to come from foreign sources. Less than one percent of the five-year commercial R&D totals were spent on commercial research that is also

applicable to defense and vice versa. This indicates that there was little direct transfer taking place between the two sectors for the targeted companies.

#### *3.3.3.1 Commercial: R&D Spending as a Percentage of Shipments*

Spending on R&D equaled 5.2 percent of commercial shipments in 2005, up from 4.4 percent of shipments in 2001. As a percentage of shipments, R&D spending more than doubled from the 2000 report results (1.9 percent of shipments), and an increase over the 1995 report results (3.4 percent). The higher R&D percentage of spending per shipment dollar reflects an average growth of 7.2 percent per year during 2001-2005. The annual average growth in R&D spending during 2001-2005 greatly outpaced the 2.9 percent annual average growth in shipments. *(see Figure 3.3a in Section 3.3.1*).

#### *3.3.3.2 Commercial: R&D Spending Per Employee*

Research and development spending per employee in the commercial sector totaled $17,300 in 2005, up 14.9 percent from $15,052 in 2001; the five-year annual average was $14,877. The 2005 result was more than five times the 2000 report's figure of $3,052 per employee. The 2005 result more than tripled the 1995 report figure, which was $4,733.

### ***3.3.4 Commercial Operating Income***

For the nine companies reporting operating income from commercial CAD/PAD goods, this sector reached $114.4 million in operating income in 2005, up 234 percent year-on-year from $34.2 million in 2001 (*see Table 3.3f*). In comparison to the previous five-year period, only $403,000 in operating profits was reported for this sector at the end of the period covered by the 2000 report.

The peak operating income during that period was $57.2 million in 1997; during 2001-2005, the reported high was $115.7 million in 2004. The five-year *average* of $79.4 million during 2001-2005 surpassed that 1997 peak from the previous five-year timeframe.[12]

**Table 3.3f: Operating Income in the Commercial CAD/PAD Sector, 2001-2005 (in $ 000's)**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 5-Yr Avg | CAGR |
|---|---|---|---|---|---|---|---|
| **Operating Income** | 34,236 | 56,254 | 76,575 | 115,722 | 114,363 | 79,430 | n/a |
| **% Change** | n/a | 64.3% | 36.1% | 51.1% | -1.2% | 47.0%* | 27.3% |

* % change from 2001 to 2005
Source: U.S. DOC/BIS CAD/PAD Survey 2005

Even though shipments only grew at a 2.9 percent compound annual growth rate over 2001-2005, commercial CAD/PAD operating income grew at almost ten times that rate, expanding 27.3 percent per year.

As a percentage of shipments, operating income climbed at a rapid pace from 5.4 percent in 2001 to 15.7 percent in 2005; the sector averaged 11.5 percent for the five-year period. The 2001-2005 figures are up significantly from the 2000 study, which reported a 0.12 percent operating profit margin, but are down from the 1995 study, which reported 15.5 percent. The 2000 report recorded a high of 20.2 percent in 1997, while the current period peaked in 2005.

### *3.3.5 Commercial Employment*

The commercial CAD/PAD sector employed 2,182 people in 2005, an increase of over 18 percent since 2001. Commercial employment grew by 4.7 percent since the 2000 report and by 86.5 percent since the original report in 1995. Commercial CAD/PAD employment reached its highest level in 2003 at 2,651 employees before decreasing 17.7 percent by 2005.

[12] Operating profit figures were not available in the 1995 assessment of the CAD/PAD industry.

*3.3.5.1 Commercial Production Workers*

Production workers constituted an average of 86.2 percent of all commercial CAD/PAD workers over the five-year period, reaching a high of 2,343 in 2004 before falling to 1,875 employees in 2005. The current figure represents a small 1.8 percent growth from 1,842 employees in 1999 but a significant 86.6 percent growth from 1,005 employees in 1995.

**Table 3.3g: Number of Commercial CAD/PAD Employees, 1995-2005**

| | 1995 | 1999 | | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|
| **Production Workers** | 1,005 | 1,842 | | 1,535 | 1,969 | 2,169 | 2,343 | 1,875 |
| % of Production Workers | 85.9% | 88.3% | | 83.3% | 86.1% | 87.3% | 88.4% | 85.9% |
| **Non-Production Workers** | 165 | 243 | | 307 | 319 | 315 | 308 | 307 |
| % of Non-Production Workers | 14.1% | 11.7% | | 16.7% | 13.9% | 12.7% | 11.6% | 14.1% |
| **Total Commercial** | **1,170** | **2,085** | | **1,842** | **2,288** | **2,484** | **2,651** | **2,182** |

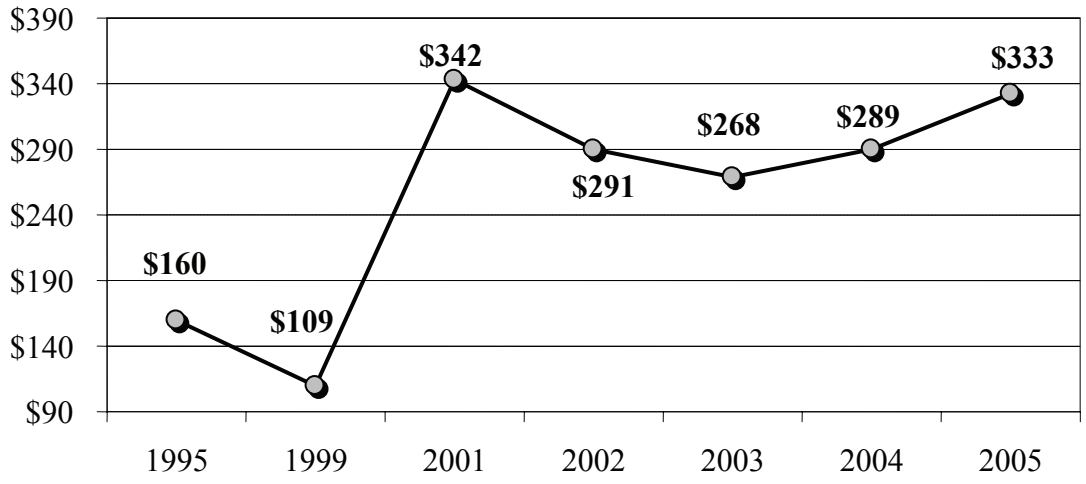
Source: U.S. DOC/BIS CAD/PAD Survey 2005

The larger percentage of commercial production workers (in 2005, 85.9 percent of commercial employees versus 59.7 percent of defense employees) reflects the industry environment of automated manufacturing, producing larger volumes of devices per order and a significantly smaller variety of product types. Moreover, the level of production workers mirrors commercial sector shipments levels over the last five years, rising each year through 2004 before easing downward in 2005. In addition, the level of non-production workers has remained flat over the 2001-2005 period, indicating that firms are satisfied with current employment levels in this employee category required to develop innovations while bringing in new production workers as needed to meet fluctuating customer order volumes.

*3.3.5.2 Commercial Productivity*

Productivity (as measured by shipments per employee) in the commercial sector more than tripled from $109,000 in 1999 to $332,843 in 2005, and more than doubled from 1995. Shipments per employee increased for three consecutive years beginning in 2003; however the compound annual growth rate during 2001-2005 remained at zero. This figure reached a high of $342,404 in 2001, reflecting a 214 percent growth over 1999 (*see Figure 3.3b*).

**Figure 3.3b: Commercial CAD/PAD Shipments per Employee, 1995-2005 (in $ 000's)**




Source: U.S. DOC/BIS CAD/PAD Survey 2005

With a flat compound annual growth rate on shipments per employee over the last five years, it appears that the commercial CAD/PAD sector may have reached its optimal efficiency level. Even with higher potential shipments due to the NHTSA mandate requiring side airbags in U.S. automobiles and light trucks beginning in 2009, the industry will likely sustain its current productivity growth rate for the next five years with existing manufacturing plant and labor capacities.

### 3.4 Employment by Job Category, Entire CAD/PAD Industry

Total employment in the CAD/PAD industry (defense and commercial) increased 14.9 percent from 3,624 to 4,625 during 2001-2005. Large increases occurred in sales/marketing, senior management, and test operators, at 23.1 percent, 21.9 percent, and 21.8 percent respectively. The largest decrease in employment occurred in the administrative staff category, falling 14 percent. Other decreases occurred in the programs/production management (-14.2 percent), and support technicians/quality assurance (-0.1 percent) categories over the five-year period (*see Table 3.4a*).

The number of manufacturing personnel, the largest occupation category based on number of employees, increased 20.5 percent from 2001 to 2005. Manufacturing employees represented nearly 64 percent of all employees in 2005. Non-manufacturing personnel increased from 1,419 to 1,508, a 6.3 percent increase from 2001 to 2005. Design/development staff was the largest group of non-manufacturing employees, representing over 27 percent of the total in 2005.

**Table 3.4a: Number of Employees By Occupation (Defense and Commercial), 2001-2005**

| Occupation Category | 2001 | 2002 | 2003 | 2004 | 2005 | 5 Year Change |
|---|---|---|---|---|---|---|
| Manufacturing Workers | 2,205 | 2,623 | 2,775 | 2,972 | 2,657 | 20.5% |
| Design/Development Staff | 406 | 429 | 411 | 413 | 410 | 0.9% |
| Support Technicians/Quality Assurance | 310 | 384 | 360 | 289 | 307 | -0.9% |
| Senior Management | 126 | 149 | 137 | 142 | 153 | 21.9% |
| Test Operators | 78 | 95 | 91 | 95 | 95 | 21.8% |
| Finance/Accounting | 79 | 77 | 79 | 80 | 94 | 18.5% |
| Human Resources | 75 | 77 | 75 | 72 | 77 | 2.7% |
| Purchasing/Procurement | 65 | 73 | 70 | 70 | 76 | 17.7% |
| Administrative Staff | 84 | 80 | 79 | 68 | 72 | -14.2% |
| Program/Production Management | 67 | 79 | 75 | 68 | 62 | -7.8% |
| Contracts Administration | 56 | 57 | 55 | 56 | 60 | 6.4% |
| Sales/Marketing | 38 | 44 | 45 | 47 | 47 | 23.1% |
| Research Staff | 9 | 10 | 8 | 8 | 14 | 55.6% |
| Total Direct Employees | 3,603 | 4,186 | 4,263 | 4,386 | 4,131 | 14.7% |
| Outside Consultants | 21 | 22 | 21 | 31 | 34 | 61.9% |
| **Grand Total** | **3,624** | **4,208** | **4,284** | **4,417** | **4,165** | **14.9%** |

Source: U.S. DOC/BIS CAD/Pad Survey 2005

### *3.4.1 Design Engineers*

Design engineering is one of the most important technical areas of employment in the CAD/PAD industry. Table 3.4b shows the distribution of experience of CAD/PAD design engineers (in years) based on five experience levels: less than five years; 5-10 years; 11-20 years; 21-30 years; and, more than 30 years experience. Over the five-year period, average experience for four design engineering disciplines (not including outside consultants) was 17.1 years.

| Table 3.4b: Experience Level of Design Engineering Staff, 2005 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Design Engineering Discipline | Total Employed | Experience Level Distribution | | | | | Average Experience (Years) |
| | | <5 Years | 5-10 Years | 11-20 Years | 21-30 Years | >30 Years | |
| Mechanical | 245 | 9.4% | 19.2% | 48.6% | 14.7% | 8.2% | 16.4 |
| Chemical | 45 | 2.2% | 2.2% | 51.1% | 26.7% | 17.8% | 23.8 |
| Electrical | 52 | 23.1% | 17.3% | 38.5% | 11.5% | 9.6% | 15.6 |
| Laser | 9 | 0.0% | 55.6% | 44.4% | 0.0% | 0.0% | 10.8 |
| Outside Consultants | 18 | 0.0% | 0.0% | 22.2% | 33.3% | 44.4% | 35.3 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | | | | |

The largest group of design engineers was the mechanical discipline, with 66.4 percent of all design engineers reported. More than 71.4 percent of reported mechanical engineers had less than 10 years of experience. Laser engineers accounted for only 2.4 percent of all design engineers. Within the experience ranges, mechanical engineers accounted for 63.9 percent of the lowest range (less than 5 years) and 75.8 percent of the 5-10 year range.

# 4. Competitive Assessment

## 4.1 Competitive Prospects: Company Views

Firms classified as small, medium or large were asked about the competitive outlook of their U.S.-based CAD/PAD production over the next five years.[13] To measure the degree of competitiveness, survey respondents provided one of five prospective outlooks ranging from "improve greatly" to "decline greatly."

Twenty of 25 (80 percent) companies provided feedback on their level of competitiveness, although not every firm answered each particular question in the section. Twelve companies reported on their level of competitiveness in the past five years (*see Table 4.1*). With regard to the next five years (2006-2010), 17 companies responded. One company responded that because winning bid prices were no longer published, they were unsure about their current competitive standing.

All twelve companies that reported on their competitiveness from the previous five years indicated that their competitiveness level was unchanged or had improved. The twelve companies projected that their competitiveness would improve during the next five years (two large, two medium, and eight small companies). Of those twelve, one indicated that its competition prospects would improve greatly while eleven indicated that their competitiveness would improve somewhat.

[13] As discussed in Chapter 2, company size was determined by annual sales. Small companies < $10 million, medium companies $10-$49.99 million, and large companies $50 million and up.

| Table 4.1: Competitive Levels in 2001-2005 (12 companies) | | | | |
|---|---|---|---|---|
| **Declined Greatly** | **Declined Somewhat** | **Remained the Same** | **Improved Somewhat** | **Improved Greatly** |
| 0 | 0 | 4 | 6 | 2 |
| **Competitive Prospects in the 2006-2010 (17 companies)** | | | | |
| **Decline Greatly** | **Decline Somewhat** | **Remain the Same** | **Improve Somewhat** | **Improve Greatly** |
| 0 | 3 | 2 | 11 | 1 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | | |

The surveyed small companies provided a number of reasons for a positive future competitive outlook. Consistent delivery of high quality products, getting listed as a second source, and improving production capabilities were three of the strategies employed by responding small companies. A competitive strategy executed by one small company included the acquisition of a competitor's assets; another listed possessing the capability for subassembly manufacturing. A third small company is serving as a rapid response organization to remain highly competitive. Others cited growth on the organizational level, in the level of capital equipment, and in the product line as reasons for their optimism.

Factors relating to size of the firm contributed to the positive levels of future competitiveness reported by the medium and large companies. One mid-sized company reported a strong competitive position based on fewer small business competitors. One large company highlighted the incorporation of new technology into the production of its defense CAD/PADs as a way to generate greater future market share. Another large company noted its ability to withstand increasing customer pricing pressures to sustain its long-term competitiveness level.

For those expressing less positive outlooks for future competitiveness, the market, production capabilities, and government sole source solicitations were listed as primary reasons. One small company cited a need to improve its own production capabilities, while another small company expressed concern that U.S. Department of Defense spending might decline, thereby reducing future revenues. A mid-sized company perceived government sole source solicitations as hindering free market access to contracts.

## 4.2 Industry Consolidation[14]

The CAD/PAD industry in 2001-2005 featured approximately 35 companies of varying sizes and capabilities. This is a similar number of firms (34) as reported in the 2000 DOC CAD/PAD report.

In late 2000, Procyon Technologies acquired 100 percent controlling interest in Scot Inc. and McCormick Selph. At approximately the same time, Goodrich bought OEA Aerospace which included its explosives and testing facility near Fairfield, California.

In 2001, the Pacific Scientific Energetic Materials Company acquired the aerospace business of a competitor, Special Devices Inc. Pacific Scientific's stated goal was to expand their product offerings, achieve economies of scale, and increase market share and technical expertise. At the time, Special Devices had made a corporate decision to pursue a more commercial line of automobile airbag initiators, and divested their defense work to Pacific Scientific in order to raise capital for the commercial venture. Special Devices also sold a portion of its aerospace division to Procyon Technologies in 2001. Finally, Pacific Scientific acquired Quantic Industries in late 2001.

In 2003, Procyon sold McCormick Selph to Pacific Scientific, completing Pacific Scientific's stated strategy of purchasing, or otherwise acquiring, smaller CAD/PAD and pyrotechnics producers near its Hollister, California headquarters.

In 2004-2005, two smaller firms, Networks Electronic Company and MK Ballistics Systems, altered their internal ownership structures. However, this had no impact on overall operations at their facilities.

Survey participants were also asked to comment on the effects of mergers, acquisitions and takeovers in their current business activities. Approximately half of the respondents indicated that they still have concerns about mergers and acquisitions affecting competitiveness, access to

[14] Merger and acquisition information derived from public sources.

supply of parts and components, and driving up costs. Some firms mentioned that of greater concern than acquisition by another CAD/PAD competitor is the purchase of a company by a big investment firm, which could invalidate a company's small business set-aside status. Fearing that consolidation will affect the supply chain, one company said that it will respond by developing more in-house manufacturing of assemblies that might otherwise have been sent to subcontractors. Price pressures as a result of consolidation are also perceived as a real problem, not just today, but also over the long-term.

## 4.3 Foreign Competition

### *4.3.1 Defense Industry: Martin–Baker Aircraft*

In October 2001, Martin-Baker Aircraft, a British company that controls 75 percent of the world ejection seat market, won the U.S. Air Force Joint Strike Fighter (JSF) aircraft ejection seat program contract.[15] This projected 20-year program could generate approximately 4,500 U.S. and international aircraft orders in total.[16] A SIES conversation with a DOD JSF program office representative highlighted the current plan for all JSF production planes to be fitted with the Martin-Baker Mk-16E ejection seat.

In almost all cases, Martin-Baker is the sole CAD/PAD source for its seats currently sold to the U.S. Government. This sole source status can prevent U.S. CAD/PAD companies from having access to subcontract opportunities on the JSF, the Joint Primary Aircraft Training System (JPATS) T-6A and other aircraft equipped with Martin Baker seats. The Joint Primary Aircraft Training System T-6A is a training aircraft with 2 ejection seats. The JPATS contract was awarded to Raytheon in 1996 and is projected to sell an initial quantity of 782 planes through 2017; 300 planes have been sold as of April 2006.[17]

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[15] Martin-Baker News. "Martin-Baker Aircraft Company Wins Queen's Award for Enterprise: Sustainable Development." April 21, 2004.
[16] Australian Government Department of Defense. Australian Participation in the Joint Strike Fighter Program: Fact Sheet: Lockheed Martin F-35 Joint Strike Fighter. July 12, 2004.
[17] Magoffin, Maj. Douglas and Laura McGowan. Aeronautical Systems Center Public Affairs, Wright-Patterson Air Force Base. "Air Force accepts delivery of 300th T-6A." April 14, 2006.

The only American-manufactured ejection seat recently integrated into a new military aircraft was the ejection seat in the U.S. FA-22 fighter jet. As of 2006, the U.S. Air Force is planning to purchase 180 F-22 aircraft, down from 750 initially planned in 1986.

Over the long-term, the U.S. CAD/PAD firms will face significant lost revenue opportunities during the life of the JSF and JPATS T-6A programs, as each seat uses 15-20 CAD/PADs, plus initial sales and replacements. It should be noted that the loss of revenue opportunities to Martin-Baker supported systems has remained an issue for the U.S. CAD/PAD industry since the release of the first Commerce CAD/PAD report in 1995.

Moreover, there are similar concerns over the U.S. ejection seat industrial base staying competitive and financially viable over the long term based on the loss of the JSF seat contract. A 1997 assessment by the U.S. DOC on the Emergency Aircraft Ejection Seat Sector recommended that the U.S. "support teaming/licensing agreements with foreign manufacturers for production sharing and technology exchange on a worldwide basis," to help maintain a diminishing domestic manufacturing base and increase national security protections through enhanced controls over technology transfers.[18] Additionally, it was recommended that the U.S. modify its munitions export controls to mirror the UK two-tier system, thereby expediting the trade of non-lethal ejection seats and increasing new customer opportunities for U.S. manufactured seats and related CAD/PADs.

### *4.3.2 Other Foreign Defense Competitors*

Another significant competitor, French supplier Akzo Nobel, has left the CAD/PAD industry since the 2000 report was completed, creating an opportunity for U.S. producers to expand their market share in the European Union.

[18] U.S. Department of Commerce, Bureau of Export Administration, Office of Strategic Industries and Economic Security. *National Security Assessment of the Emergency Aircraft Ejection Seat Sector: A Report for the U.S. Department of the Air Force*, November 1997, p. 82.

### *4.3.3 Dual-Sourcing*

One recommendation of the 2000 CAD/PAD report was to have DOD require a portion of CAD/PADs for the JSF ejection seat, by far the largest aircraft contract for the foreseeable future, at a level that would have a meaningful positive impact on U.S. industry shipments. Since the release of the 2000 report, DOD has proposed dual-sourcing of all military contract CAD/PADs except on ejection seats, which comprise the bulk of the defense CAD/PAD sector. With this qualifier, dual-sourcing of non-ejection seat-related CAD/PAD contracts between two competing U.S. companies could have deleterious effects on the domestic industry because of the effect of splitting up already limited volume production opportunities industry-wide. If implemented, the concept would cut into volume shipments and significantly harm smaller producers over the next five years in a market that experienced shipments growth from 2001 to 2005. For the 5-year period, defense shipments grew 19.5% year-over-year, an average of 3.9% per year.

Cost efficiencies are lost because the first units developed in a contract order prove to be the most expensive due to costs associated with product design and testing, labor learning curve, and production times. Capacity utilization rates can also drop below financially viable levels due to dual sourcing requirements, potentially hurting investment and R&D levels of the firms.

### *4.3.4 Satellite Launch Industry*

According to the Satellite Industry Association, global shipments in the satellite launch industry significantly dropped from $4.2 billion in 1996 to $2.8 billion in 2004, a 33 percent decrease.[19] Less than ten percent of the industry is space related CAD/PADs. The final launch of the Titan-IV rocket in October 2005 may reduce the number of future satellite launches, which would in turn stem this type of CAD/PAD revenue in the future.[20]

[19] Futron Corporation and Satellite Industry Association, "State of the Satellite Industry" – Report, June 2005.
[20] Lockheed Martin, "Lockheed Martin's Last Titan IV Successfully Delivers National Security Payload to Space," Press Release, October 19, 2005.

### *4.3.5 Foreign Commercial Competitors: Autoliv*

For the commercial CAD/PAD industry, Autoliv from Sweden stands as the current market leader in the U.S. and abroad. With the NHTSA regulation, which will take effect in 2009 requiring side airbags in newly manufactured U.S. automobiles and light trucks, the company is well positioned to significantly grow over the next five years and beyond. Continuous downward pricing pressures applied by U.S. and other global automakers will likely make this sector more competitive for both domestic and foreign producers, but will nonetheless offer lucrative opportunities.

### *4.3.6 Foreign Competition: Competitive Assessment*

Twelve of 25 surveyed companies assessed their competitiveness level against international competition over 2001-2005. Four companies reported some improvement while six found that their competitiveness level stayed the same. Two of the firms reported a decline in their competitiveness level. None of the respondents noted that their competitiveness level improved greatly during this timeframe.

**Table 4.3: Competitive Assessment Against International Competitors, 2001-2005**

| Level of Competitiveness | Number of Firms Reporting | Percent Distribution |
|---|---|---|
| Improved Greatly | 0 | 0.0% |
| Improved Somewhat | 4 | 33.3% |
| Stayed the Same | 6 | 50.0% |
| Declined Somewhat | 1 | 8.3% |
| Declined Greatly | 1 | 8.3% |

Source: U.S. DOC/BIS CAD/PAD Survey 2005

International competitors were identified in the following countries: France, the United Kingdom, Germany and Israel; U.S. companies were also cited as overseas competition, likely because of foreign military shipments. Companies not participating in our survey that were listed as foreign competitors included: Martin-Baker (UK- 3 mentions), Dassault (France- 2

mentions), and eleven others. Internationally competitive products mentioned by respondents included: aircraft emergency ejection seats and related CAD/PADs, gas generators, initiators, missile components, space vehicles, and other CAD/PAD products.

It should be noted from the 1995 BIS industry report that foreign competition was not considered to be a major problem because of the specialty products, tests and other requirements needed for U.S. government purchases. However, in the subsequent 2000 report, survey respondents were concerned that more foreign firms were winning U.S. military contracts and that U.S. shipping costs were becoming prohibitive.

U.S. CAD/PAD firms are generally optimistic that they will be able to keep pace or improve their competitive position against foreign CAD/PAD producers over the next five years based on utilization of efficient production techniques and R&D spending. However, if U.S. military procurements flatten or decline, some manufacturers may be forced out of the CAD/PAD business.

### 4.4 Certifications

Certifications are optional evaluations of a company to help a customer recognize the firm's commitment to manufacturing quality products and services. These certifications represent international standards for goods and services; a certified company guarantees consistent quality of its goods and/or services, and routinely improves production techniques/outcomes.

CAD/PAD companies reported on the adoption of ISO 9001, Mil-Q-9858A, Six Sigma, and NASA Handbook 5300 certifications.[21]

The ISO 9000 family of certifications was designed by the International Standards Organization to recognize companies for quality management systems. In addition to standardizing regulatory

[21] Several companies listed additional certifications, to include the AS9100, TS16946, ISO-17025, NADCAP, Mil-I 45208 and the SO9001-2000. These, along with the NASA Handbook 5300, have been classified as "Other" in this section.

requirements, the Organization promotes customer satisfaction and continual improvement of product performance.

The ISO 9001 was the most popular certification within the CAD/PAD industry during the 2001-2005 period. Of the 16 small companies, 11 were ISO 9001 certified and two were working towards certification.[22] These statistics reflect an increasing percentage of smaller firms pursuing the ISO 9001 certification. In 2000, three of the 15 surveyed firms (20 percent) were certified (*see Table 4.4a*).

Five medium-sized companies were ISO 9001 certified and one was working towards certification. Of the large firms, two had ISO 9001 certification and one was working towards qualifying; this displays a 100 percent interest by both the medium and large-sized companies for the ISO 9001 certification in 2005.

In 2000, nine of 11 companies (81 percent) with shipments greater than $10 million were ISO 9001 certified; in 2005, seven of nine companies (89 percent) were ISO 9001 certified.[23]

The Mil-Q-9585A is a production control/quality management certification covering Department of Defense applications preceding ISO 9001. In most instances, the Mil-Q-9585A has been entirely replaced by ISO 9001. Several companies continue to use methods that meet Mil-Q-9585A certification requirements as they are cross-referenced in ISO 9001 demands. The few respondents not currently certified by the ISO 9001 have been Mil-Q-9585A certified in the past. These companies did not specify whether certification will be sought in the future (*see Table 4.4a).*

[22] For the purpose of this report, annual sales were used to determine company size. Small companies < $10 million, medium companies $10-$49.99 million, and large companies >$50 million.
[23] In the 2000 CAD/PAD study, companies were classified by sales >$10 million and sales <$10 million. Therefore, in some instances the medium and large sized firms for 2005 have been combined into one group to provide a more accurate data comparison from 2000-2005.

| Table 4.4a: Certifications, CAD/PAD Small Firms (<$10 million in shipments) | | | |
|---|---|---|---|
| **Category** | **Yes** | **No** | **Working Toward** |
| ISO 9001 | 11 | 2 | 2 |
| Six Sigma | 2 | 8 | 2 |
| Mil-Q-9858A | 9 | 3 | n/a |
| Other* | 5 | 6 | 1 |
| **Certifications, CAD/PAD Medium Firms ($10-$49.99 million in shipments)** | | | |
| **Category** | **Yes** | **No** | **Working Toward** |
| ISO 9001 | 5 | n/a | 1 |
| Six Sigma | 3 | 1 | 2 |
| Mil-Q-9858A | 4 | 2 | n/a |
| Other | 3 | 3 | n/a |
| **Certifications, CAD/PAD Large Firms (>$50 million in shipments)** | | | |
| **Category** | **Yes** | **No** | **Working Toward** |
| ISO 9001 | 2 | n/a | 1 |
| Six Sigma | 1 | 1 | n/a |
| Mil-Q-9858A | 1 | 2 | n/a |
| Other | 3 | n/a | n/a |
| * "Other" includes the NASA Handbook 5300, AS9100, TS16946, ISO-17025, NADCAP, Mil-I 45208 and the SO9001-2000.<br>Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | |

Six Sigma, another certification used in CAD/PAD production, is a data-driven approach used to improve product quality by measuring defect levels per million units produced.[24] Firms are ranked within the Six Sigma certification system based on the number of defects from production.

Survey respondents indicated that Six Sigma was not as popular as ISO 9001 in the CAD/PAD industry. Of the sixteen small companies, two were certified and two were working towards Six Sigma certification, up from zero companies in 2000. Three of the six medium-sized firms were certified and two were working towards certification. Only one large company reported being Six Sigma certified in 2005. In 2000, only one firm out of nine with shipments greater than $10 million was certified (*see Table 4.4a)*.

[24] A defect is defined as anything that does not match customer requirements for a good or service.

### *4.4.1 Customer Technical Capabilities*

Customer technical capabilities affect the efficiency of the contracting process. BIS-surveyed companies were asked about the technical capabilities of their customers, and the ease which products are sold and incorporated into DOD and prime contractor applications.

Survey respondents were asked to evaluate whether the level of customers' technical understanding had improved in the last five years, remained the same, or eroded. More than half of the respondents said that customer technical capabilities were relatively unchanged for three of the four categories over the last five years. The results were broken down by company size.

**Table 4.4b:Trends in Customer Technical Capabilities, 2005**
**Small Firms (shipments <$10 million)**

| Technical Capability | It has Improved | Remained the Same | It has Eroded |
|---|---|---|---|
| Preparation of Technical Specifications | 1 | 12 | 2 |
| Technical Knowledge of Your Product | 3 | 7 | 5 |
| Technical Discussion of Ordnance Application in Their System | 3 | 9 | 2 |
| Technical Ability to Evaluate Proposed Design and Compare | 2 | 9 | 3 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | |

The first question addressed the customer's capability to prepare technical specifications for the firm. Twelve small companies saw no changes in industry abilities; one firm acknowledged improvement, while two noted eroded capabilities (*see Table 4.4b*). Smaller BIS survey respondents reported more changes in the customer's technical knowledge of CAD/PADs. Of the fifteen firms answering these questions, five thought the technical knowledge had declined in recent years, and only three saw an improvement.

Next, surveyed firms responded to whether customers were able to discuss the technical application of the product with the buyer's system. Nine of the smaller firms highlighted no changes in these abilities; three thought discussions had improved, and two noted the value of discussions had declined.

Finally, companies reflected on the technical ability of their customers to evaluate proposed designs and make comparisons with other CAD/PAD products. Again, nine small firms reported no changes in these abilities, two noted these abilities had improved, and three thought they had eroded.

| Table 4.4c: Trends in Customer Technical Capabilities, 2005<br>Medium Firms ($10≤$50 million in shipments) | | | |
|---|---|---|---|
| **Technical Capability** | **It has Improved** | **Remained the Same** | **It has Eroded** |
| Preparation of Technical Specifications | 1 | 3 | 2 |
| Technical Knowledge of Your Product | 2 | 2 | 2 |
| Technical Discussion of Ordnance Application in Their System | 1 | 3 | 2 |
| Technical Ability to Evaluate Proposed Design and Compare | 1 | 4 | 1 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | |

As shown in Table 4.4c, one of the medium firms thought that the customer's preparations of technical specifications had improved, while three thought they were stagnant in recent years, and two thought the quality of these preparations had declined. With regard to the technical knowledge of the product, two medium firms witnessed improvements, two noted erosion, and two recognized no changes in these capabilities.

For discussions of ordnance applications, three medium companies reported no changes in their interactions with customers. One firm acknowledged improvement in their customer-supplier communication, and two firms noted declined value in these discussions. The customer's ability to evaluate proposed designs has not changed for four medium-sized firms. One firm thought the abilities had improved, while one noted the opposite.

| Table 4.4d: Trends in Customer Technical Capabilities, 2005<br>Large Firms (shipments≥$50 million) | | | |
|---|---|---|---|
| **Technical Capability** | **It has Improved** | **Remained the Same** | **It has Eroded** |
| Preparation of Technical Specifications | 0 | 2 | 0 |
| Technical Knowledge of Your Product | 0 | 2 | 0 |
| Technical Discussion of Ordnance Application in Their System | 0 | 1 | 1 |
| Technical Ability to Evaluate Proposed Design and Compare | 0 | 1 | 1 |
| Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | |

Larger firms reported no improvements in customer capabilities in any of the four addressed categories. Of the two large reporting companies, both witnessed no changes in their customer's capabilities as far as their preparations of technical specifications, or technical knowledge of the product was concerned. For the technical discussion of ordnance application to the systems, and the technical abilities to evaluate proposed designs and make comparisons, one company noted no changes, while one witnessed erosion in customer abilities.

| Table 4.4e: Trends in Customer Technical Capabilities, 2005<br>All Responding Firms | | | |
|---|---|---|---|
| **Technical Capability** | **It has Improved** | **Remained the Same** | **It has Eroded** |
| Preparation of Technical Specifications | 2 | 17 | 4 |
| Technical Knowledge of Your Product | 5 | 11 | 7 |
| Technical Discussion of Ordnance Application in Their System | 4 | 13 | 5 |
| Technical Ability to Evaluate Proposed Design and Compare | 3 | 14 | 5 |
| **Percentage Distribution** | | | |
| **Technical Capability** | **It has Improved** | **Remained the Same** | **It has Eroded** |
| Preparation of Technical Specifications | 8% | 68% | 16% |
| Technical Knowledge of Your Product | 20% | 44% | 28% |
| Technical Discussion of Ordnance Application in Their System | 16% | 52% | 20% |
| Technical Ability to Evaluate Proposed Design and Compare | 12% | 56% | 20% |
| *percentages based on 25 survey respondents<br>Source: U.S. DOC/BIS CAD/PAD Survey 2005 | | | |

In sum, only two of 23 respondents (eight percent) thought capabilities to prepare technical specifications had improved in the last five years, 17 reported no changes (68 percent), and four (16 percent) reported erosion. More companies experienced changes in customer's technical knowledge of CAD/PADs. Five of 23 respondents (20 percent) thought the customer's familiarity with the product had improved while seven respondents (28 percent) thought the opposite (*see Table 4.4e*).

A total of 13 of 22, or 52 percent, companies witnessed no changes in the abilities to discuss the technical application of the product with the buyer's system; four firms (16 percent) reported an improvement, and five (20 percent) responded that the customer discussions were eroding.

Lastly, only three of 22 companies (12 percent) reported an improvement in customer understanding; fourteen, or 56 percent, evaluated the situation as having stayed the same since 2000, while five (20 percent) others reported erosion.

# 5. Factors Affecting the CAD/PAD Industry

## 5.1 Government Regulatory Issues

CAD/PAD companies were asked to recommend "reasonable adjustments" to U.S. Government policies, laws, and regulations in several areas, including environmental and worker safety regulations, shipping classifications, and export controls. The full list of questions can be found on pages 12-13 in Part III of the survey, a copy of which is provided in Appendix F.

### *5.1.1 Environmental and Worker Safety Regulations*

Previous BIS reports illustrated concerns that environmental and safety standards were not being applied evenly across states or localities. To evaluate developments in this area, the 2005 survey requested information on the companies' relationships with various key government agencies as well as suggested adjustments to U.S. Government policies, laws, and regulations that would moderate any competitive disadvantages faced by U.S. firms as a direct result of current policies, laws, and regulations.

Two of sixteen companies acknowledged an improvement in their relationship with the Department of Labor's Office of Safety and Health Administration (OSHA) since the BIS 2000 report. The remaining companies responded that these relations had not improved (two companies), that the question was not applicable (four companies), or that they were unaware of any changes (eight responses of "Do Not Know"). Responses concerning relations with the Environmental Protection Agency (EPA) were similar, with two companies reporting improved relations, three reporting no improvement, and the majority responding that they "do not know" if there have been improvements.

Some companies expressed concern regarding the adoption of new regulations that resulted in increased noncompliance situations. Regulations were deemed by some as becoming cumbersome, while another suggested that greater coordination between federal, state, and local governments was critical. Greater coordination between EPA and the Department of Defense

(DOD), as suggested in the 2000 report, was not addressed by any of the eight companies who responded to this question.

### *5.1.2 Shipping Classifications*

Shipping classifications for CAD/PAD products remain a concern for many of the companies that responded to the survey. The Department of Transportation (DOT) requires that new commercial shipments receive a letter of "Recommendation for Classification" from a designated testing facility, followed by a letter of "Competent Authority" to ship from the Department's Office of Hazardous Materials. These regulations are codified in Title 49, Section 173.356 of the Code of Federal Regulations and can result in a costly and lengthy process for firms. This process can discourage CAD/PAD firms from participation in commercial markets, with the hidden cost associated with the delay in obtaining an approval being lost export sales. However, industry comments were generally favorable according to feedback from four company site visits and seven of twenty-five companies that responded to this question.

Dr. Wei Shing Chang runs a consulting business to test and analyze CAD/PAD products for shipping, and prepares letters of recommendation to the Department of Transportation once his analyses are completed. He has over 30 years experience, and many CAD/PAD companies use his services. An interesting change was noted from the 2000 report whereby some companies are now using competing contractors to fulfill this logistical step.

Two companies found that various shipping classification levels placed on ordnance components are overstated and should be lowered, and in many cases, the CAD/PAD classifications were too stringent. The classification process was also observed to be too lengthy, especially when going through the Naval Surface Warfare Center at Indian Head.

Moreover, one large company viewed the Department of Homeland Security procedures for handling hazardous materials as hindering international trade and the U.S. industry's global competitiveness. The company reported that congestion at shipping ports was rooted in archaic procedures and union rules which increase fees, slow operations, and constrain business process flows.

#### *5.1.2.1 U.S. Department of Transportation*

Three companies would like to have the authority to classify devices with similar functionalities instead of having to utilize outside organizations to perform this function. Companies noted that ammunition manufacturers are the competent authority in lot acceptance testing for their products. This would allow the DOT and approved sources to classify products in a more timely fashion.

One small company found that DOT licensing approval times are erratic and that the department can sometimes be unresponsive because it is understaffed for the larger volume of tests required since September 11, 2001. However, the firm was pleased with the overall service it received from DOT. A mid-sized company viewed DOT procedures as "providing good business practices with an effective general concept, particularly for overseas shipping." Moreover, this firm discovered that DOT is not resistant to approving a family of products to reduce its workload, which would better serve industry needs by expediting the licensing process.

#### *5.1.2.2 Inventory Storage*

Consistent interpretations and application of rules was a common theme by reporting firms throughout the survey sections covering government regulations. When storing inventories, one small company responded that it wants a definitive Bureau of Alcohol, Tobacco, and Firearms (BATF) item classification of DOD CAD/PADs on explosive classes to store products accordingly and reduce potential violations. The company was unclear whether DOD Safety Storage procedures or BATF interpretation of them takes precedence when applying these rules.

### ***5.1.3 Export Controls***

Six of the eight reporting companies who reported issues with governmental export controls listed their main concerns as being the length of the licensing approval process and the problem of which federal agency has commodity jurisdiction in each case. Many companies stated that the protracted process has made it difficult for them to compete for international contracts.

There is a general recognition of the importance of the regulations, but there is also a consensus that the process needs to be changed in order to keep American companies internationally competitive. Some respondents expressed concern regarding perceived discrepancies in the application and interpretation of these regulations across different government personnel.

#### *5.1.3.1 U.S. Governing Offices for CAD/PAD Export Licenses*

The export approval process is divided into three separate license requirements: 1) approval of a bid proposal; 2) an export license; and 3) a re-export license. Export approvals of CAD/PADs are managed by three U.S. government offices:

1. The Department of Commerce, which controls the export and re-export of items subject to the Export Administration Regulations (EAR) through the Bureau of Industry and Security, in conjunction with the Departments of Defense and State;
2. The Department of State, which controls the export and re-export of items subject to the International Traffic in Arms Regulations (ITAR) through the Directorate of Defense Trade Controls, in conjunction with;
3. The Department of Defense, through the Defense Technology Security Administration (DTSA).

Since September 11, 2001, companies reported the perception that national security concerns have slowed the export licensing process, which can sometimes take several months to one year for a government-approved license. Also, companies reported that these same concerns impeded their ability to obtain commodity jurisdiction on ITAR-controlled CAD/PADs for use in strictly commercial applications. One company suggested the creation of a preferred or trusted vendor list in order to expedite the export licensing process. These lists would be compiled by the Department of State, Department of Defense, Environmental Protection Agency, and the Department of Transportation.

*5.1.3.2 Licensing Process*

To expedite the licensing process, some companies apply for commodity jurisdiction to get certain CAD/PAD goods reclassified as commercial, rather than military, products. One respondent noted that lethal U.S. pistol and rifle ammunition are often licensed quickly for worldwide sale, but companies selling significantly less powerful non-munitions explosives and propellants are subject to a lengthy State Department licensing process to export their goods. Three companies noted that they would prefer to have blanket licenses to shorten the export process.

One respondent noted that greater scrutiny is applied to acquire an Explosives Handling permit than when obtaining a security clearance classification. Moreover, companies are required to maintain certified copies of BATF lists of customers, making it more difficult to work with smaller contractors who may not be represented on these lists. Based on company visits and surveys, the licensing process takes two to seven times longer than five years ago, and the process does not guarantee that a license will be granted. The slowdown affects all participants in the CAD/PAD chain, restricting U.S. competitiveness and exports.

*5.1.3.3 Licensing and Overseas Competition*

Concerns remain that substitutes for U.S. CAD/PAD products can be acquired from overseas companies with shorter lead times than can U.S. exports because of the lengthy U.S. licensing process. The lengthy process can disqualify U.S. products from some overseas contracts, making it more difficult to compete; this echoes industry concerns from the 1995 and 2000 CAD/PAD reports. Licensing timeframes are a large barrier for U.S. companies; they all but eliminate the opportunity to enjoy the advantage of being first to market, as well as increasing overseas customer response times.

Three respondents suggested making non-munitions CAD/PAD products subject to the EAR rather than continuing to make them subject to the ITAR to expedite the licensing process and improve company positions in the international market. One company found that current export

controls inhibit the ability to participate in new program proposals, given the duration associated with obtaining approval of technical assistance agreements from the State Department. A separate concern was raised that if the export licensing process remains lengthy and foreign competitors become more adept at producing CAD/PAD devices, greater numbers of foreign military sales (FMS) could be lost over the next ten years. This could eliminate FMS revenues for the industry, potentially harming profits, research and development, and capital investment.

#### *5.1.3.4 Defense Technology Security Administration*

One company reported that the high turnover rate of employees at DTSA, the agency in charge of reviewing export licenses for the Defense Department, is likely to affect interpretation of regulations due to the lack of personnel experience, further slowing the export licensing process for U.S. companies. With greater scrutiny on all goods subject to the ITAR after September 11, 2001, export licensing offices are understaffed at the Department of State and DTSA, thus contributing to slowing export sales.

### *5.1.4 Item Unique Identifiers*

Item unique identifiers (IUIDs) are special labels used to identify and track CAD/PAD products and components. Beginning on October 1, 2006, Indian Head will require IUIDs on all new CAD/PADs that are serially managed and tracked (based on criteria), and some prime contractors are already requiring this tracking tool. Any CAD/PADs produced under contracts prior to this date are not subject to the new regulation. Prime contractors and subcontractors have until July 30, 2007, to submit their IUID data to the Indian Head registry. [25]

The justification behind IUID use is to improve item management and accountability; improve asset visibility and life cycle management; and to provide clean audit opinions on item portions

[25] Estrada, Victor. "CAD/PAD Item Unique Identification (IUID)." Presentation delivered to Technical Exchange Workshop hosted by Indian Head Naval Surface Warfare Center Division, April 19, 2006.

of DOD financial statements. Moreover, the tags will be leveraged to integrate item data across DOD to help achieve global interoperability.[26]

The IUID labels have a higher per unit cost than older, thinner labels, and purchases of a special printer, two-dimensional scanner and verifier are required to produce and read them. The benefit of the new labels is that each one contains up to 100 times more information than a traditional bar code label, resulting in a more robust tracking capability.[27] According to one industry representative, the duration that IUIDs need to be readable depends on contract specifications. Readability can be required for 5-7 years, considerably longer than older label types.

It is likely that IUIDs will add to government contract costs. However, Indian Head is seeking an open dialogue with private contractors to determine these costs.

## 5.2 Government Competition with Industry

In addition to government regulatory controls, another topic of continued concern for the CAD/PAD industry is competition with government manufacturing. The Naval Surface Warfare Center in Indian Head, Maryland produces a portion of CAD/PADs sold to the U.S. Government. In past years, the private CAD/PAD industry has highlighted that production at Indian Head has created a competitive relationship between government and industry production and sales, resulting in a loss of business for the private firms.

### *5.2.1 Industry Perspective*

For 2005, nine out of 25 companies, or 36 percent, responded to the question regarding government participation within the CAD/PAD market. These nine firms included seven small companies, one medium company, and one large company.[28] Five of these firms reported

[26] Ibid.
[27] Ibid.
[28] For the purpose of this report, we classified companies based on annual sales. Small companies < $10 million, medium companies $10-$49.99 million, and large companies ≥$50 million.

limited or no government competition with the private CAD/PAD industry; the remaining four companies have experienced challenges in securing government contracts.

One firm noted that industry faced hidden costs when bidding against the government for contracts. Another firm argued that government competition should only exist when a true cost model proves the government option is the lowest-cost approach. Two companies approved of government participation in new product introductions or when products are manufactured with limited resources.

The four respondents that expressed difficulty in obtaining government orders were small companies. One firm noted that orders for their most productive items have declined in the past five years due to increased manufacturing at the Indian Head CAD/PAD facility; another firm mentioned that products produced at Indian Head are often not available for open bidding, making it impossible for industry to compete.

The seven small companies responding constitute 44 percent of the total number of small firms represented in this study. All seven were reluctant to support government-industry competition. Two of these firms are among those that support market participation from the government only when new products are introduced to the market or supply constraints exist. Three other companies were concerned with lost opportunities due to Indian Head production, dominance of the market by larger companies, and limited competitive product bidding.

In 2000, 10 out of 24 surveyed firms (almost 42 percent) supplied feedback on this matter; nine companies supported limiting government participation in both the domestic and international markets. With only 7 of 25 firms raising concerns in 2005, there seems to be slightly reduced concerns within the industry.

In the initial CAD/PAD study in 1995, 25 out of 35 (71 percent) companies raised concerns with government competition. These companies thought the federal government was competing with private firms in at least one of the following CAD/PAD areas: manufacturing, testing, or research and development.

Indian Head officials noted a 1993 Government Accountability Office investigation that reported a small degree of actual competition, and that the nature of Indian Head's activities was within acceptable bounds under the U.S. Office of Management and Budget Policy Circular No. A-76.[29] The purpose of the circular was to establish federal policy regarding the government's performance of commercial activities. In sum, the policy states that the government should not compete with private industry; rather, it is to rely on commercial sources to supply needed products and services. The A-76 document has not been discussed in survey responses since the 1995 report.

### *5.2.2 Competitive Bidding*

Survey respondents were asked to provide commentary on the competitive bidding process. Seven of the 25 (28 percent) surveyed companies provided feedback, and six of these seven firms were considered small companies.[30]

The six smaller firms represent 38 percent of small company respondents. Some small companies listed having the lowest price as the biggest factor in the bidding process while others mentioned that competition from larger market participants and contract sizes as the main restrictions to their market viability.

To improve the competitive bidding process, two small companies recommended utilizing the "best value" process. This technique could potentially relieve some of the stresses of the smaller firms, as the best value process evaluates factors beyond price to award contracts. Other suggestions included restricting the contract sizes of competitors with limited experience, and improving the clarity of technical proposals. With larger firms underbidding to eliminate competition, smaller companies are concerned with potential future financial strains.

[29] See www.whitehouse.gov/OMB/circulars

[30] For the purpose of this report, we classified companies based on annual sales. Small companies < $10 million, medium companies $10-$49.99 million, and large companies ≥$50 million.

## 5.3 Small Business Set-Asides

The Small Business Administration (SBA) Set-Aside Program was developed to allow certain government contracts to be awarded exclusively to small businesses. The program goal is to help grow and develop small businesses and to ensure that they have an opportunity to participate. The set-aside program requires that the small business be price and quality competitive, is capable of producing the needed quantities, and can meet the delivery schedules prescribed in the government contract. The Federal Acquisition Streamlining Act of 1994 raised the dollar value of government contracts automatically set aside for small businesses from $25,000 to $100,000. Contracts over $100,000 may also be set aside for small firms when there is a prospect that bids will be received from two or more responsible small businesses.

In addition to the set-aside, the SBA 8(a) Contracting Program also directs work toward small firms. It takes its name from section 8(a) of the Small Business Act and Public Law 95-507. Small, socially and economically disadvantaged firms that are certified by SBA are eligible to receive non-competitive Federal contracts for up to $5 million if qualified as a manufacturing firm (the limit is $3 million for a service firm).

Twelve of 25 companies commented on the Small Business Set-Aside Program. Six favored the program while two were against it. Two companies suggested rewriting the statute, while two other companies wanted better enforcement of existing laws.

The six companies supporting the program were seeking more set-asides for subsystems and sole source products, and better access to the bidding process. Two respondents want to allow larger businesses to compete with smaller ones to maximize market opportunities. One respondent supports the program, but wants to preclude small subsidiaries of large firms from competing for the contracts. Similarly, another respondent would like the Federal Acquisition Regulations to stipulate that a qualifying small business does not have a controlling financial interest by a larger company. Yet another proponent finds that the capability to deliver large government order quantities contradicts the program intent of helping small companies − which sometimes may only have the capacity to produce smaller order lots − to secure federal contract work.

One respondent noted that it qualifies as a small business under the North American Industry Classification System, but does not have a SBA certificate because it would not help gain business and only create more paperwork. In the opinion of another program detractor, small business set-aside products do not perform up to specification requirements and create additional expenditures and delays in product deliveries. A third respondent wants the program reduced, while another believes that set asides impede technology development.

Small Business Administration set-asides are only authorized if a business can meet federal government contract terms and conditions. It has been reported to BIS that some companies receive SBA certifications and win DOD bids without the capabilities to fulfill CAD/PAD contracts; when this occurs, the cost per item can exceed the original price by a factor of three. The inability to fulfill contracts also causes time delays, which can bring military activities to a standstill until critical items can be procured.

### 5.4 Small Business Innovation Research Program

The Small Business Innovation Research (SBIR) Program was established under the Small Business Innovation Development Act of 1982 (P.L. 97-219). The Small Business Research and Development Enhancement Act (P.L. 102-564) reauthorized the law through September 30, 2000, and the law was reauthorized again through September 30, 2008, by the Small Business Reauthorization Act of 2000 (P.L. 106-554). The program funds small businesses trying to commercialize technology, product, or service innovations and compete with larger businesses for federal government research and development awards. In order to participate, businesses must be American-owned, independently operated and for-profit; the principal researcher must be employed by the business; and the company size is limited to 500 employees.[31]

According to a 2005 Government Accountability Office (GAO) report, the SBIR program is achieving its goals to "enhance the role of small businesses in federal R&D; stimulate

[31] U.S. Small Business Administration, Office of Technology, *Description of the Small Business Innovation Research Program*.

commercialization of research results; and support the participation of small businesses owned by women and/or disadvantaged persons." Companies in general gave the program high ratings. Concerns over the program included "inconsistent interpretations of extramural research budgets by participating agencies, geographical concentration of awards in a small number of states, and lack of clarification on the emphasis that agencies should give to a company's commercialization record when assessing its proposals." The report notes that most concerns have been addressed through Congressional reauthorizations.[32]

Only five of the twenty-five respondents answered the SBIR question, and their opinions were mixed. One of the respondents did not have any familiarity with the program, and another was highly interested in learning more about it. One company found it difficult to obtain the small business ownership certification, and was not certain of which resources to utilize to attain this status and compete for SBIR and other small business government contracts. Another company did not always find the small business status to be beneficial as it lost a government contract with a lower bid to a larger company with a more recognizable name.

A respondent noted that larger businesses may have more resources to address innovative research efforts. Another company would like to open SBIR initiatives to all business sizes to ensure that every technology is considered before a contract decision is rendered. Moreover, one company urged increasing the SBIR government funding share from 50 percent to 60 percent. However, the low level of response could indicate that SBIR is not an issue of concern for the respondents; or it could indicate that SBA could do more to educate companies about the program.

### 5.5 Performance Specifications

Eight of nine companies responding favored performance specifications over build-to-print work orders. In brief, build-to-print provides a manufacturing blueprint to the CAD/PAD firm.

[32] Mittal, Anu K. "Observations on the Small Business Innovation Research Program," Testimony before the Committee on Science, Subcommittee on Environment, Technology and Standards, U.S. House of Representatives, U.S. Government Accountability Office, June 28, 2005.

Performance specifications allow latitude in how to make the device with full engineering knowledge of the end-use application.

Respondents argued against build-to-print mainly due to its use of archaic and more expensive technology, design, and performance limitations specified in government contracts. One respondent observed that build-to-print prevents newer and more cost effective technologies from being implemented because replicating 20-to-30 year old technology inhibits industry from moving forward. Another company indicated that build-to print typically requires additional analysis and time because critical data is sometimes missing.

One company noted that build-to-print is more price-competitive, and the revenue is welcomed with flatter industry sales. However, a problem noted with most build-to-print designs is that the work is never build-to-print due to the customizations required for each finished product. A second company found it difficult to improve upon products based on build-to-print designs and prefers performance specifications.

One respondent claimed that Indian Head management will defend a build-to-print design even when it is apparent that the design has shortfalls, and recommends that the government should be more receptive to adopting functions which meet the product performance specification needs. A second respondent alleged that some government solicitations are referred to as performance specifications but are restricted by build-to-print constraints of legacy products. Another respondent remarked that too many build-to-print packages do not perform as required, and that performance-oriented awards could help resolve the situation.

### 5.6 Lot Acceptance Testing

Seventeen of twenty-five firms recommended policy adjustments to moderate disadvantages presented by government lot acceptance testing (LAT). Fifteen companies noted that the process needs improvement; two companies responded that no improvement was necessary. Consistent with the 2000 CAD/PAD report, none of the current survey respondents suggested that lot acceptance testing should be conducted exclusively at Indian Head. Hill Air Force Base in Utah,

which operates under the authority of the Joint Program Office, has traditionally allowed LAT at company locations. But this is due more to the limited resources at Hill AFB, than to a specific decision to allow companies this option. Hill AFB wants to standardize classifications with Indian Head to create more consistent testing requirements under the Joint Program Office leadership.[33]

The majority of firms responding noted that the requirement for testing CAD/PADs at Indian Head adds details and costs to the production process, but does not add value to the finished goods. These added costs include lead times for scheduling testing, transportation, and extra labor hours. Relying on testing by defense CAD/PAD manufacturers will cut costs, reduce time to market, and enable these companies to operate more efficiently. Some CAD/PAD suppliers already have complete in-house destructive and non-destructive testing capabilities, and maintain that internal controls provide assurance of optimal product capabilities.

A respondent noted that an inequity exists between Air Force and Navy testing requirements; the Air Force permits contractors to administer LAT while the Navy elects to perform its own on certain contracts. Four respondents explicitly supported performing testing at the supplier facility. However, one respondent suggested that if a supplier demonstrates unacceptable testing methods, any and all subsequent LAT should be monitored at a government facility and witnessed by the customer. Indian Head representatives currently observe one survey respondent's testing procedures, but the firm noted that it may not be practical or cost effective for Indian Head to monitor all on-site testing.

Two respondents would like to see shorter testing times. One company indicated that average schedule delivery enhancements are typically 30-60 days, compared to equal or longer timeframes for LAT at government facilities. Discrepancies can sometimes exist between the company and the Navy test fixtures and methodologies, lengthening the production cycle. One respondent suggested tailoring government solicitations to define test sequences, the number of test articles, and maximum lot size to expedite the testing process. A separate respondent remarked that first article units often bare no relationship to the production run, and in some

[33] http://www.hill.af.mil/main/index.html

cases, the number of first article and LAT units exceed the number of deliverable units, drawing out the production schedule, increasing costs, and constraining both buying and selling parties from delivering the finished product.

Survey respondents argued that streamlining LAT to in-house testing by manufacturers will help reduce waste, some of which is hazardous. Other streamlining suggestions included eliminating the lot release process for Navy orders, reducing the LAT requirements for mature products with proven reliability, and shrinking the LAT sample size based upon historical performance.

### 5.7 Production Bottlenecks – Supply Shortages

Some of the responding CAD/PAD companies expressed concerns about the supply base. Vendors continue to exit the market or are consolidated with other firms, reducing the number of supply sources. One example cited is the ongoing bankruptcy of Eagle Picher Technologies, a major supplier of CAD/PAD inputs. If other domestic suppliers leave the industry, some U.S. producers would have would have to procure from foreign sources. This in turn would stretch out the production cycle, considering the longer timeframes required since September 11, 2001 to acquire import licenses for military goods and manufacturing inputs. Companies reported that the licensing process can take as long as several months.

Anecdotal evidence points to foreign countries purchasing larger quantities of raw materials in the open market to fulfill their future needs, thus raising demand, hiking prices of inputs and creating shortages, and making it more difficult for companies to reach targeted profit margins. Shortages include chemicals for assembly such as PBXN-7, black powder, plastics (due to hurricane Katrina), and metal cartridges. As was the case five years ago, RD1333 and specialty metals are still difficult materials to find.

Companies can sometimes create workarounds, for example formulating an alternative chemical compound to fulfill an order, but product functionality must ultimately adhere to government regulations to meet contract specifications. However, the lack of available inputs often requires firms to invest days or weeks to locate acceptable alternative suppliers that are U.S.- or foreign-

based, stretching out lead times and overall production cycles. Moreover, a concern was raised that federal government contracts do not take this additional lead time into account when materials are unavailable, making it more difficult for companies to complete contract orders.

While Indian Head possesses a large number of back-up materials to supply hard-to-find manufacturing inputs, it too is having difficulty in acquiring certain parts from suppliers. CAD/PAD manufacturers also have concerns over their suppliers losing key personnel, which can detract from their technical capabilities to produce updated products and raise prices of supplies due to higher labor costs associated with paying fewer qualified employees to produce manufacturing inputs.

Over the next five years, the growth of the CAD/PAD industry by foreign competitors, economic expansions of China, India and other countries, and increased trade flows of the open market may reduce an already tight supply for hard-to-find specialty metals, RD1333, and other assembly materials. Collectively the shrinking base of raw materials and longer production cycles associated with extended licensing periods will likely increase production costs and customer response times, making it more difficult for U.S. defense manufacturers to compete for both foreign and domestic military contracts.

### 5.8 Foreign Sourcing and Dependencies

Of the 25 respondents, ten reported a dependency on foreign sources to maintain operations. Reasons for foreign sourcing included no known domestic source; domestic sources were inadequate; lower cost sourcing from overseas; foreign sources supplemented domestic sources; foreign sources were of higher quality or reliability; and in one case, a domestic source was on strike. Companies reporting data have imported manufacturing inputs from the United Kingdom, Germany, France, Japan, Mexico, the Czech Republic, Canada, Sweden, and Poland. Examples of imported CAD/PAD manufacturing inputs include lithium anode, zirconium, lead azide, copper tubing and headers.

To date, the war efforts in Iraq and Afghanistan have not interrupted supply lines, but the possibility exists for future U.S. military conflicts, which could make foreign sourcing more risky. While the countries listed as originating foreign sources are generally considered secure, free market forces in rapidly growing economies which may not be strong allies with the U.S. could make the future procurement of foreign inputs more arduous and increase the vulnerability of domestic firms to supply shortages.

For the ten companies that use foreign sources, most reported using up to five percent of all raw materials from these sources. One company noted that restrictions associated with Federal Acquisition Regulation and Defense Federal Acquisition Regulation clauses incorporated into government CAD/PAD solicitations and contracts are limiting the ability of suppliers to utilize foreign sources of specific metal components. Considering the current state of the U.S. steel base, it is likely that acquiring foreign metal components for domestic CAD/PAD production will remain problematic as long as current regulations remain in place.

# 6. 2006 Report Findings and Recommendations

## 6.1 Findings

- U.S. defense and commercial CAD/PAD manufacturers have evolved sufficiently so as to no longer be part of the same industry. This coincides with changes noted in BIS's 1995 and 2000 national security assessments of the CAD/PAD industry, indicating an increasingly divergent trend in the aerospace and automotive sectors. The commercial sector is now 60 percent larger than the defense sector in terms of shipments.

- Defense shipments of individual CAD/PAD product categories were mixed during 2001-2005. New orders for two of the primary products of the Defense CAD/PAD sector – ejection seats system CAD/PADs and rocket motors were flat or declining. Future growth will depend on U.S. manufacturers' access to Joint Strike Fighter (JSF) and Joint Primary Aircraft Training System (JPATS) ejection system program work. Currently these programs, including the ejection seat CAD/PADs, are dominated by a foreign firm, Martin-Baker Aircraft of the United Kingdom.

- As a result of the overall slowdown in military aircraft exports, smaller than expected orders for new U.S. fighter aircraft (F-22), and the retirement of many legacy aircraft (i.e., F-15, F-16), the U.S. market share in ejection system CAD/PADs is at risk of diminishing sharply in the next decade, possibly leading to a loss of domestic manufacturing capability. This concern was previously raised in BIS's 2000 report.

- Shipments of consumable CAD/PADs, like electronic impulse cartridges and aircraft stores (for countermeasures dispersal) are tied closely to war fighting and have seen significant increases in 2001-2005 since the beginning of U.S. military operations in Afghanistan and Iraq. Demand for these items is unlikely to decrease in the near-term.

- Acquisition of raw materials on the global market has become more expensive, making it more difficult for defense CAD/PAD companies to compete domestically. International

competitors for these materials, like China and India, lower the supply and drive up the price of critical materials. This makes it increasingly difficult for U.S. CAD/PAD companies to obtain needed materials, let alone at prices which allow them to bid competitively for DOD contracts.

- Since September 11, 2001, companies noted a significant increase in State Department export license approval time, which now can take months to obtain instead of a few weeks, as in the 1990s. Delays in export licensing negatively affect "time to market" and hamper U.S. companies who are increasingly losing military sales to overseas competitors or giving up on export markets altogether. Based on the successful list reassignment of automotive airbags from the U.S. Munitions List (USML) to the Commerce Control List (CCL) several years ago, some U.S CAD/PAD companies are thinking about seeking commodity jurisdiction for CAD/PADs currently controlled on the USML to allow their use in non-DOD satellites and other commercial space applications

- Very few foreign sourcing instances were noted, and none of the 25 companies who responded to the BIS survey identified foreign sourcing as a problem (except for pricing of certain raw materials). Also, no problems with sole-sourcing (foreign or domestic) of materials, part, and components were noted.

- Instead of the current military standard of "built to print" manufacturing specifications, companies overwhelmingly favored performance specifications to allow more modern and efficient technologies to be used in developing and producing products.

- Exports of defense CAD/PAD products did not represent a significant share of overall shipments, averaging about 7 percent during the current study period. This was not unexpected, since defense exports have traditionally been low in the previous BIS CAD/PAD industry assessments. By contrast, the five-year average of commercial exports during 2001-2005 was approximately 29 percent of total shipments.

- The operating income of defense CAD/PAD companies (as a percentage of shipments) grew modestly during 2001-2005. Defense CAD/PAD companies were profitable each year during 2001-2005.

- Capital expenditures at defense CAD/PAD companies fell over 30 percent from 2001 to 2005. However, capital expenditures in 2005 were still slightly higher than expenditures noted in the 1995 and 2000 BIS reports, indicating an interest in rebuilding capacity, tooling, and other hardware.

- Research and development (R&D) spending for both the defense and commercial CAD/PAD sectors was significantly higher across the board for 2001-2005 than in previous BIS assessments. The majority of this funding was provided by in-house revenues. There is little U.S. Government-funded R&D supporting the defense manufacturers. Increased R&D spending in the defense sector is a positive development for the future of defense CAD/PADs. There was more R&D spending by the larger companies in the defense sector; very little by the smaller companies. Larger defense companies seem to be positioning themselves for future technology and process improvements, and remain the innovation drivers in the defense sector.

- Employment levels for defense CAD/PAD producers rose 12 percent during 2001-2005; however, the 2005 level did not reach the employment levels of the 2000 and 1995 studies. Employment levels for commercial CAD/PAD producers rose 18 percent during 2001-2005, after a 10 percent drop from the 2000 study, and the number of production workers fluctuated with revenues.

- By a wide margin, defense CAD/PAD companies would prefer to conduct lot acceptance testing and approve results at their own manufacturing facilities to save processing time and costs and increase speed to market. This preference was previously identified in the BIS 2000 report.

- The underutilization of Small Business Set-Asides continues to be an issue, as many small CAD/PAD producers are not taking full advantage of government-afforded benefits. However, this is also a contentious issue, as some small companies believe that larger competitors may try to acquire small firms simply in order to obtain Set-Asides.

- Dual sourcing of defense CAD/PAD contracts between competing U.S. companies can put more competitive pressure on smaller firms with low-volume operations. While second-sourcing is a good idea for the industry (especially for high-volume ejection system CAD/PAD components), and for the U.S. defense industrial base as a whole, it has the potential to drive smaller companies from the CAD/PAD industry. Dual sourcing of small volume contracts could have a negative impact, since the production volumes required by DOD may be insufficient to warrant financially viable production by CAD/PAD firms.

- A number of firms expressed concern about NSWC Indian Head being involved in production work. This is an ongoing concern, going back to BIS's 1995 study. Indian Head is a second-source and producer of last resort for many CAD/PAD products, but it is unknown how this is affecting the industry. NSWC Indian Head did not provide production data for this assessment. The number of firms raising this issue has dropped slightly since the 1995 report.

- The U.S. Department of Transportation shipping classifications approval process remains a concern for many of the defense CAD/PAD companies that responded to the survey. Some companies are now using authorized outside contractors to fulfill this need. Delays in receiving these classifications are slowing delaying shipment of product to subcontractors, and even more importantly, to customers.

## 6.2 Recommendations

- The CAD/PAD Joint Program Office should recommend to the U.S. Air Force to dual source ejection system CAD/PAD components for the Joint Strike Fighter (JSF) and Joint Primary Aircraft Training System (JPATS) aircraft programs. Unless U.S. firms are allowed to compete for JSF and JPATS ejection system CAD/PAD manufacturing, the market for which being currently dominated by Martin-Baker of the United Kingdom, the viability of the U.S. domestic industry to produce ejection system CADs and PADs could be severely degraded in the next decade.

- Federal agencies need to provide program guidance to defense CAD/PAD companies on the process of how to petition the U.S. Government to change the export licensing jurisdiction of selected items (especially for non-DOD satellites and other commercial space applications) from the ITAR to the EAR.

- The U.S. Government should accelerate the move from built-to-print specifications to performance specifications in defense contracts to allow more modern and efficient technologies to be used in developing products. Build-to-print specifications are too limiting for most CAD/PAD producers.

- Educate firms regarding Small Business Set-Asides and the Small Business Innovation Research Program through workshops for defense CAD/PAD companies who shipped less than $10 million in 2005. The CAD/PAD Joint Program Office should engage the Small Business Administration to organize and present these workshops – within the framework of the currently scheduled technical workshops.

- The CAD/PAD Joint Program Office should continue the movement towards lot acceptance testing by the companies themselves, as it will shorten production schedules, and lower costs.

- The CAD/PAD Joint Program Office should continue to advocate with the Department of Transportation to shorten the approval time for shipping classifications. This will result in getting products out the door faster, expend inventory, and help U.S. defense CAD/PAD companies better compete for domestic and international contracts.

## Appendices

# Appendix A:
# Letter Requesting Study

DEPARTMENT OF THE NAVY
INDIAN HEAD DIVISION
NAVAL SURFACE WARFARE CENTER
101 STRAUSS AVE
INDIAN HEAD MD 20640-5035

8900
Ser JPA/46
9 Aug 04

Peter Lichtenbaum
Assistant Secretary for Export Control
Bureau of Industry and Security, Room 3886
U. S. Department of Commerce
Washington, DC 20230

Dear Mr. Lichtenbaum,

At the request of the Cartridge Activated Device/Propellant Activated Device (CAD/PAD) Joint Program Office (JPO) of the Naval Surface Warfare Center, Indian Head Division, the Department of Commerce has conducted two previous studies of the CAD/PAD industrial base. The first study was completed in 1995 and the follow-up study was completed in 2000. The purpose of these studies was to analyze the long-term health and competitiveness of the CAD/PAD industry and to develop recommendations to ensure the continued ability for the industry to support defense missions and programs. We in the CAD/PAD Joint Program Office (JPO) have found these studies to be very effective in helping us manage the complexities and ever-changing nature of the CAD/PAD program, thus ensuring continued support to the war-fighter. In order for us to fully recognize the changes to the CAD/PAD industry and efficiently adapt to these changes, we request another updated study be conducted in the near future.

I have already been in contact with Mr. Brad Botwin from your office to let him know this request is coming. He did an outstanding job conducting previous studies of the industry. If you require further information concerning this request, I would be happy to meet with you. Please call me a t (301) 744-6499 if you have any questions or concerns.

Sincerely,

D. D. Williams, Director
CAD/PAD Joint Program Office
By direction of the Commanding Officer

Copy to:
Mr. Brad Botwin

# Appendix B:
# Product Descriptions and Illustrations

## APPENDIX B: Product Descriptions and Illustrations

Product descriptions and illustrations of several types and varieties of CAD/PAD products used by the military are presented here to give the reader a better appreciation of the nature and complexity of the items and how they perform their intended functions. Written product descriptions are given first; illustrations are shown at the end of the appendix. As described in the body of the report, CAD/PADs are used by the military for many aircraft from aircraft engine fire extinguishers and aircrew emergency escape systems, to aircraft anti-missile counter measures and many other uses.

* * * * *

**Impulse Cartridges** have numerous applications. For example, in the event of a fire, the aircraft fire extinguisher is activated by an impulse cartridge (**figure 1**), which releases a fire extinguishing agent into the area surrounding the aircraft engine. The fire extinguisher cartridge is electrically initiated. Pressure from the main propelling charge (initiator) forces the puncture device into motion. The contents of the fire extinguisher are retained by disc type plugs at the valve opening. Upon operation of the unit, the cartridge fires a slug which breaks the disk, permitting the fire retardant charge to be expelled through the valve.

**Detonating Cords and Charges** are used in aircraft canopy removal and included shielded mild detonating cords, linear shape charges, flexible near shape charges, mild detonating fuses, and thin layered explosive lines. Emergency jettisoning of the aircraft canopy can be accomplished internally by the aircrew or externally by rescue personnel. The canopy jettison system is also initiated automatically during the ejection sequence to provide a clear path for seat ejection. The ejection seats typically use impulse cartridges and delay initiators to position the occupant for ejection, initiating seat propulsion and stabilization devices, and to accomplish seat/occupant separation.

**Flexible Confined Detonating Cord** assemblies (**figure 2**) are used in the escape system of the aircraft to provide an explosive train linking the canopy hook removal subsystems in the cockpit. **Shielded Mild Detonating Cord** (SMDC) assemblies (**figure 3**) are explosive transmission lines, consisting of a metal sheathed explosive core, covered with a teflon coating, all contained within a thin walled stainless steel tube. SMDC is available in various lengths and bend configurations. SMDC's are also used in the emergency canopy removal system to provide an interconnecting explosive path to the window cutting assembly.

**Impulse Initiators** are devices employing energetic materials such as propellants or explosives to generate the initial or sustaining pressure within a ballistic gas system, or to initiate a signal transmission line such as SMDC. The cartridge actuated initiator (**figure 4**) is a lanyard operated device used in the aircrew escape system. Seat ejection is initiated by pulling a seat-firing handle which actuates the initiator(s). When the lanyard initiator assembly handle is pulled, the firing pins are released igniting the initiator.

Percussion initiated impulse cartridges used percussion primers to initiate energetic material. The percussion initiated impulse cartridge (**figure 5**) is the power source that actuates the pilot's canopy unlatch thruster which unlocks the canopy before canopy jettison, and supplies gas pressure to actuate two propellant actuated initiators which initiate SMDC to the canopy jettison rocket motors. When the cartridge is fired by a SMDC, pressure builds up against the firing disc to push both firing pins into the primers, which ignites the ignition charge. The igniter charge then fires the propellant charge, which produces gas pressure. The gas pressure is routed through the canopy unlatch thruster, moving the canopy to the rear of the aircraft.

**Catapults, Thrusters and Removers** use energetic materials and employ telescoping-type tubes to perform functions such as separation, ejection, thrusting or movement.

The rocket catapult (**figure 6**) is designed to remove ejection seat and aircrew member from the aircraft and propel aircrew/seat to a height necessary for safe parachute deployment. The catapult is a gas actuated, solid propellant booster rocket, which provides the initial power for the ejection of the seat. The catapult consists of an outer barrel and an inner telescopic piston. The rocket catapult is a self-contained, mechanically initiated, two stage solid propellant booster rocket. The nozzle is positioned to provide rocket thrust through the center of gravity of the aircrew/seat combination during ejection.

As the seat travels up the guide rails, the auxiliary cartridges in the catapult are fired; the emergency oxygen supply is mechanically activated; the leg restraint lines are drawn tight; and, the rocket motor initiator is fired. The impulse cartridge in the rocket motor initiator fires the underseat rocket to provide sustaining thrust for the ejection seat. The underseat rocket is fired as the catapult reaches the end of its stroke and sustains the thrust of the catapult to carry the seat to a height sufficient to enable the seat to deploy. Timing of all events after rocket motor initiation is controlled by the electronic sequencer, which utilizes altitude and airspeed information to select the correct mode of operation.

Pullers and thrusters are basically the same, except they work in reverse. The motion of the puller is inward while the thruster is outward. Power derived form a ballistic cartridge moves a piston in the desired direction. Pullers are used primarily for releasing attached components (e.g., retaining rings, pins, etc) while thrusters, working in reverse, are moving mechanisms. The cartridge actuated thruster (**figure 7**) is used to force the integrated control system tray in an upward position, providing a clear ejection path during the aircraft emergency escape sequence. It is triggered by gas pressure provided by a remote initiator.

The illustrated underseat rocket motor (**figure 8**) is used on F-14 aircraft; it is a self-contained, mechanically initiated, solid propellant rocket. The rocket motor contains 13 propellant tubes, six nozzles, and one firing unit tube. The six rocket nozzles are fitted underneath the center body and are angled outward to give maximum thrust at the center of gravity. When the seat is ejected from the aircraft, the static line, attached to the aircraft floor becomes taught and activates the firing mechanism to initiate the ignitor. The rocket motor provides thrust for approximately a half-second to propel the aircrew and seat to an altitude sufficient for safe parachute descent, even if ejection is initiated from the ground.

**Delay Cartridges and Delay Initiators** are items that incorporate pyrotechnic delay material to regulate the timing of the output charge initiation. These include electrically and percussion primed delay cartridges and delay initiators. The explosive actuated delay initiator (**figure 9**) is designed to provide a three second delay in the interseat sequencing system of the aircraft. The explosive energy from the SMDC forces the initiator firing pin to ignite a primer charge. The primer charge ignites an explosive mix which fires a fuse. The fuse provides a three-tenths second time delay before an explosive mix and booster charge is ignited. The explosive energy from the booster then fires an SMDC attached to the outlet port of the initiator.

The delay cartridge (**figure 10**) is used to actuate an automatic parachute release after a three-fourths second delay from the time it is actuated during the ejection sequence from an aircraft. As the seat is ejected from the cockpit, the firing cable is pulled, withdrawing a sear pin from the release mechanism. This action releases the firing pin which strikes the primer, igniting the delay column in sequence to the main charge. The gases actuate the parachute release actuator.

The parachute container is fitted with canopy breakers to enable the seat to eject through the cockpit canopy should the automatic canopy ejection system fail. After ejection, drogue deployment, aircrew/seat separation, and parachute deployment are automatically

controlled by an on-board, electronic sequencer. A barostatic release unit provides backup in case of partial or total failure of the electronic sequencer, and a manual override system provides a further backup in the event of failure of the barostatic release.

Gas pressure from impulse cartridges extracts the drogue chute to stabilize the aircrew seat. A time release mechanism then provides a several second delay prior to seat-occupant separation. Time delay may vary depending on altitude and airspeed conditions. At the appropriate time an impulse cartridge then releases the drogue chute from the seat. The drogue chute then deploys the parachute to separate the occupant from the seat.

**Cutters** are devices which employ energetic materials and a cutting blade to sever objects such as a bolt, wire, or cable suspension lines. There are basically two types of cutters, guillotine type and punch type. A guillotine cutter is an axe or blade knife propelled internally by an energetic material. They are used where there is a need for rapid, remote cutting of cable, wire rope, hose, or fuel line. They are designed for mechanical or electrical triggering of the cartridge. A cartridge actuated cutter, with a cartridge sealed-in, is used to sever nylon reefing line attached to a recovery parachute. This cutter consists of an aluminum tubular body containing a spring-loaded firing pin and a six second delay cartridge. Once the cartridge is fired the resulting expanding gases force the cutter blade forward, severing the reefing line, which permits full deployment of the recovery parachute.

**Ejector Cartridges** employ propellants and explosives to eject sonobouys, and to release bombs and missiles from aircraft. This category also includes cartridges that launch aircraft flares or chaff for anti-aircraft missile countermeasures. An aircraft flare ejection cartridge is designed to provide a power source for the ejection of the aircraft flares and chaff. This cartridge is electrically initiated. When fired, the resulting pressure operates the dispenser or pod.

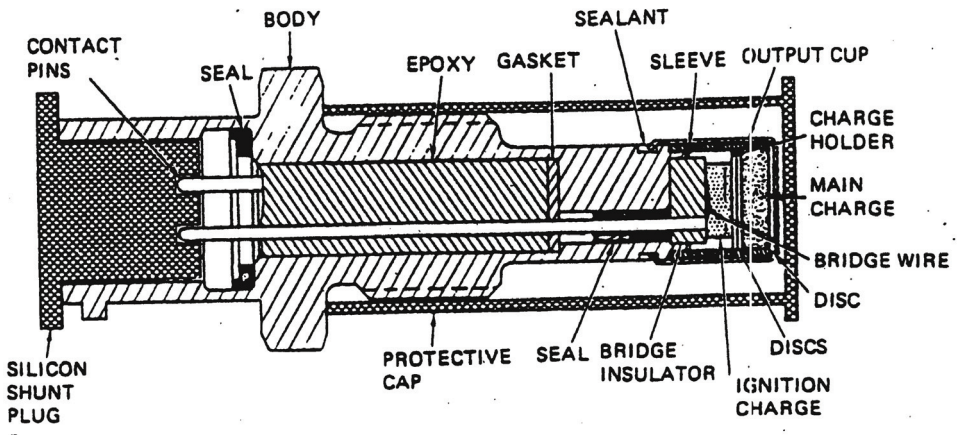


**Figure 1. Electrically Initiated Impulse (Fire Extinguisher) Cartridge**

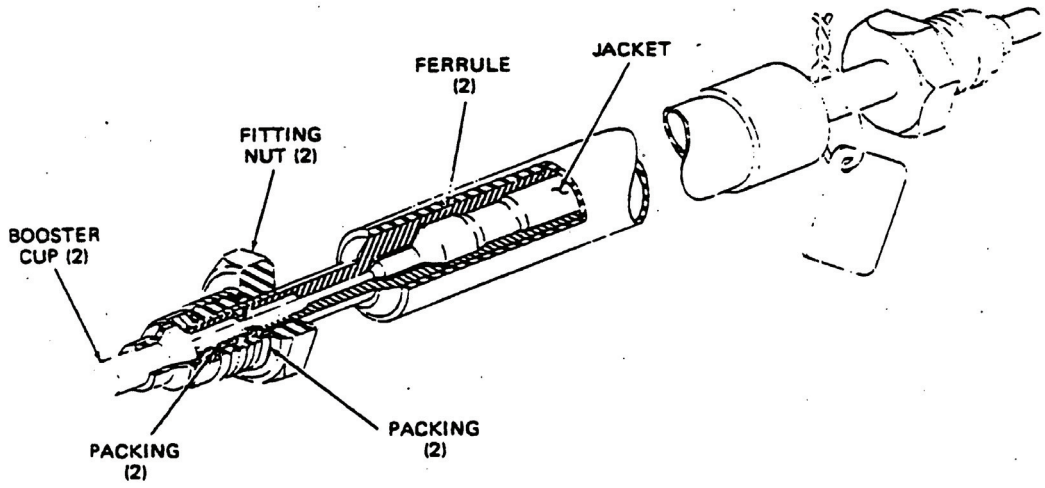


**Figure 2. Flexible Confined Detonating Cord Assembly**

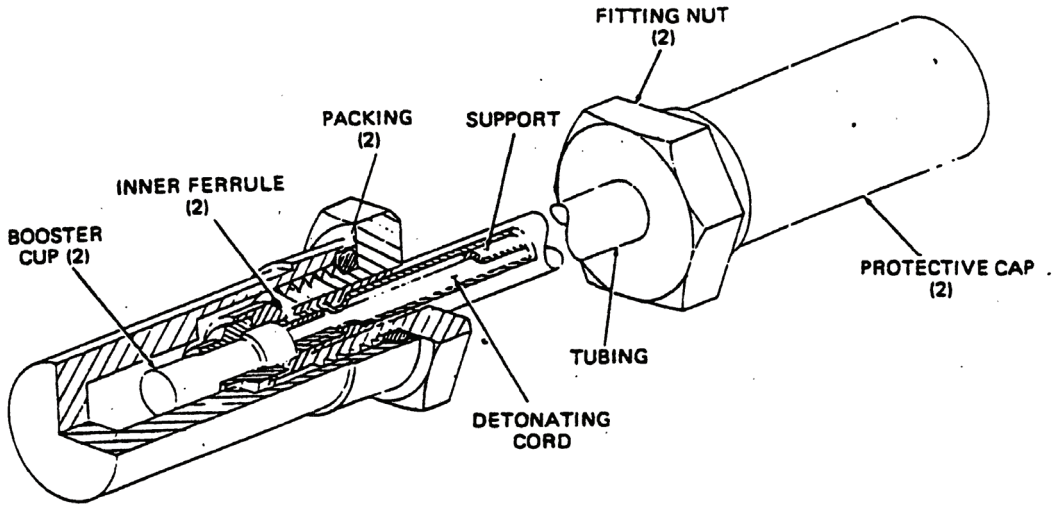


**Figure 3. Shielded Mild Detonating Cord**

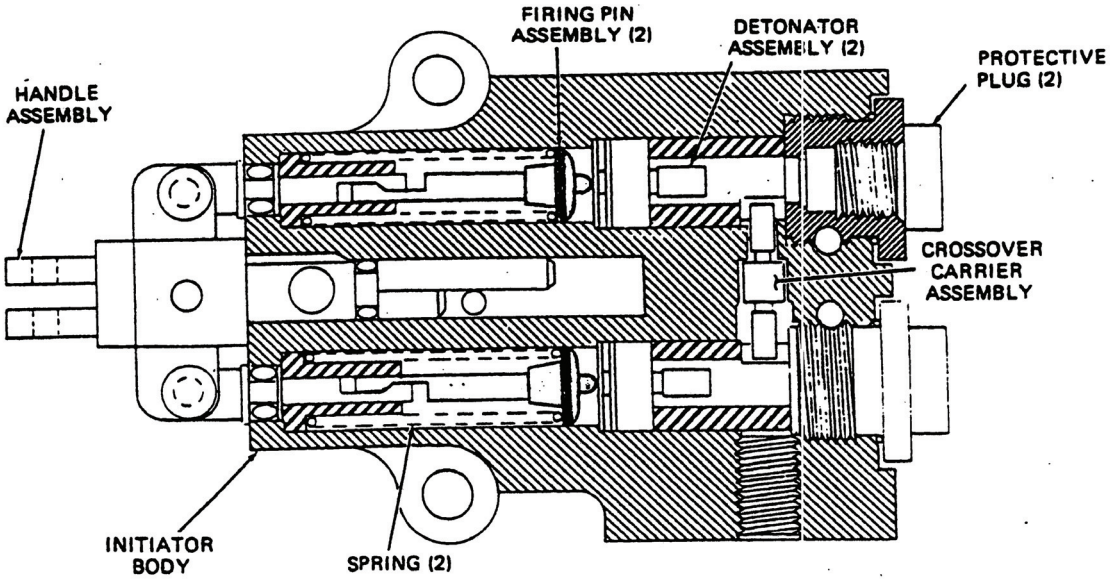


**Figure 4. Impulse Initiator**

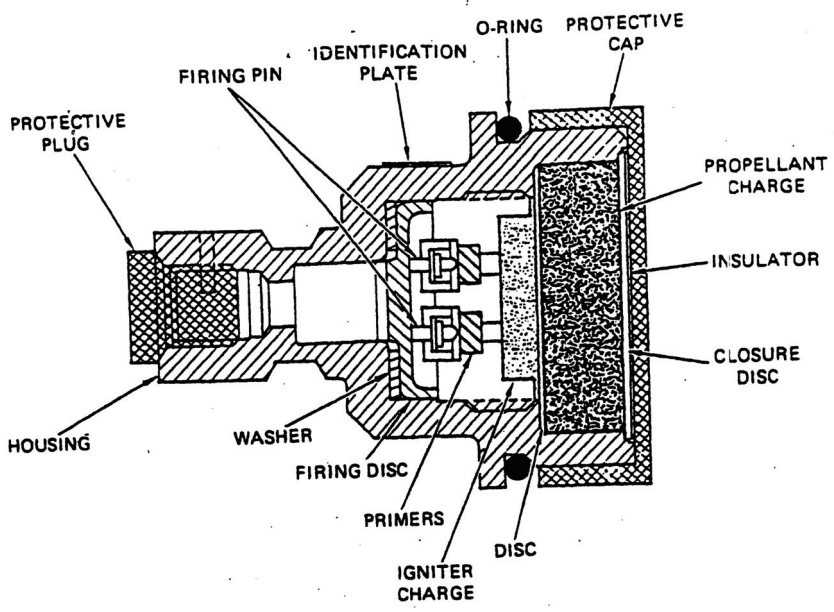


**Figure 5. Percussion Initiated Impulse Cartridge**

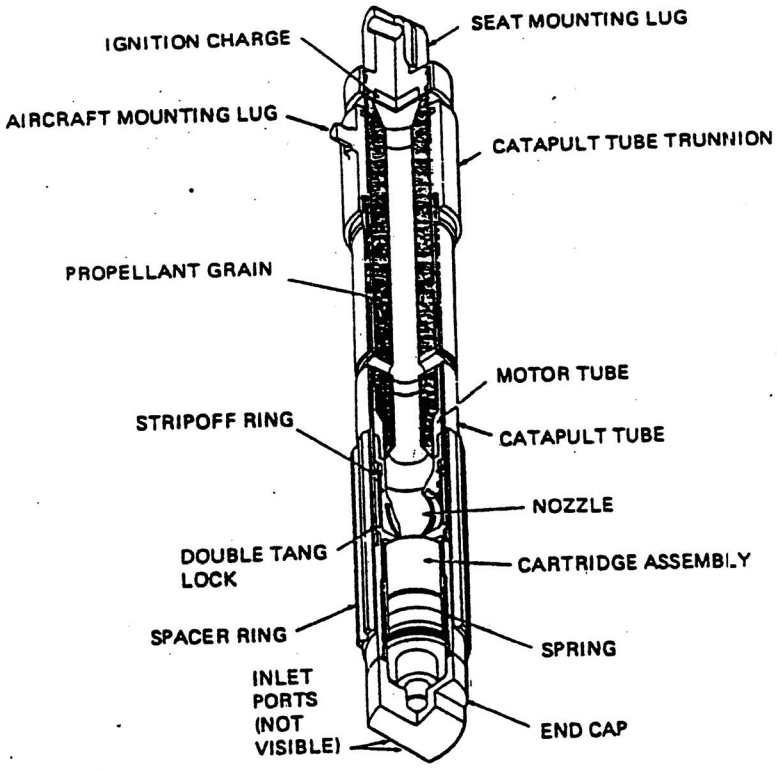


**Figure 6. Rocket Catapult**

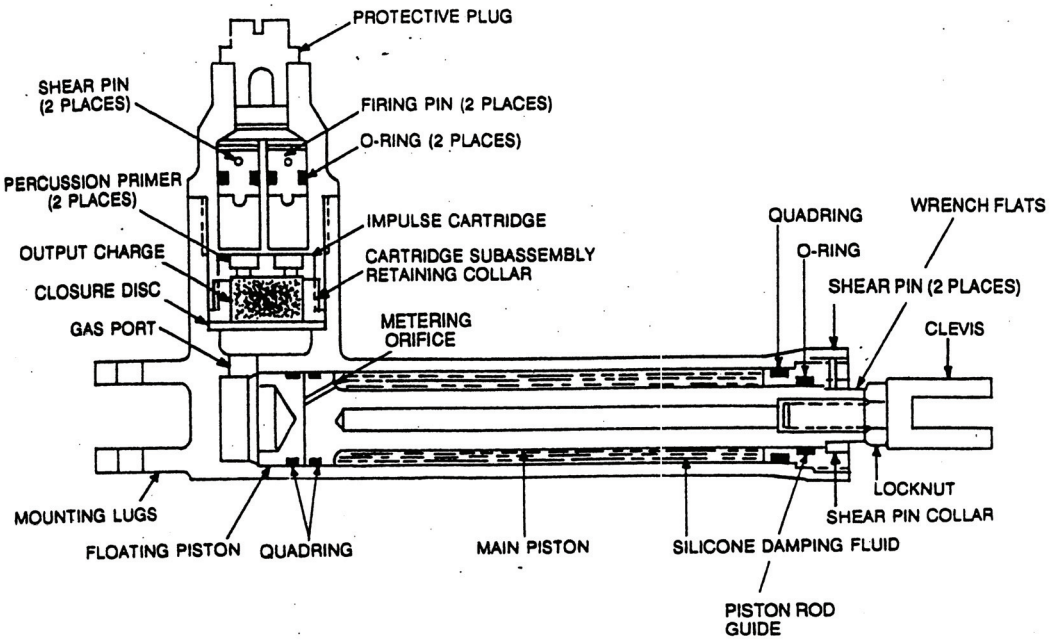


**Figure 7. Thruster**

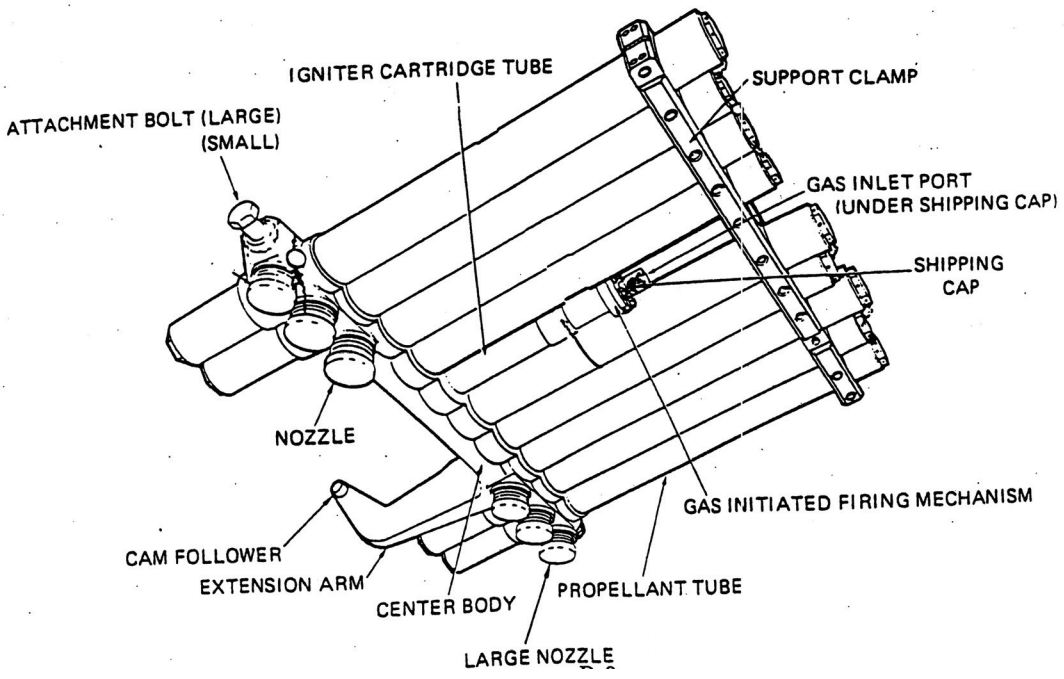


**Figure 8. Underseat Rocket Motor**

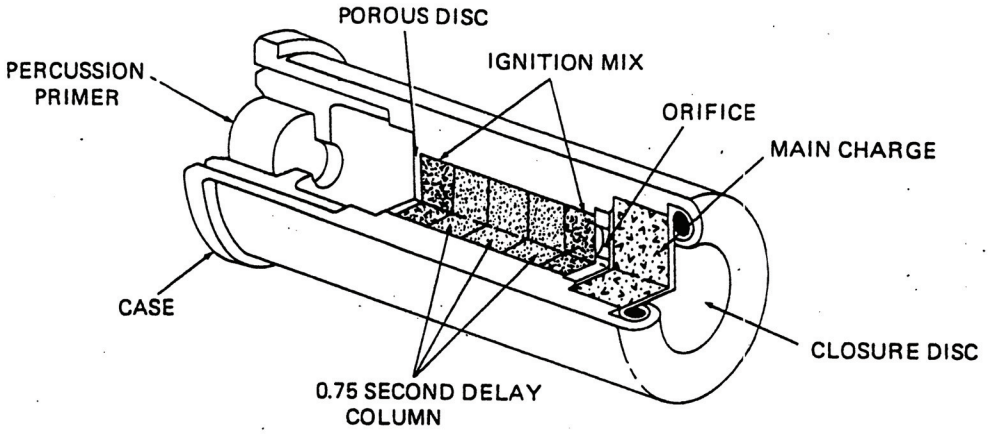


**Figure 9. Delay Initiator**

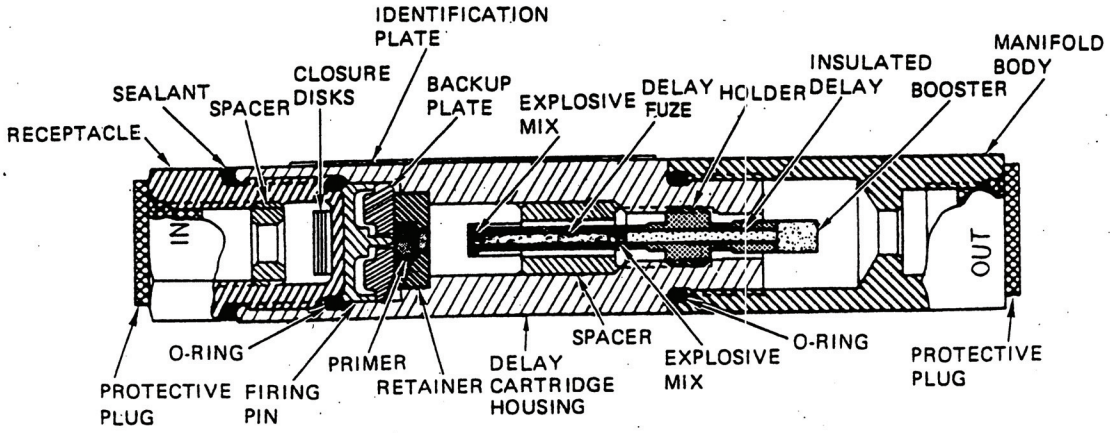


**Figure 10. Delay Cartridge**

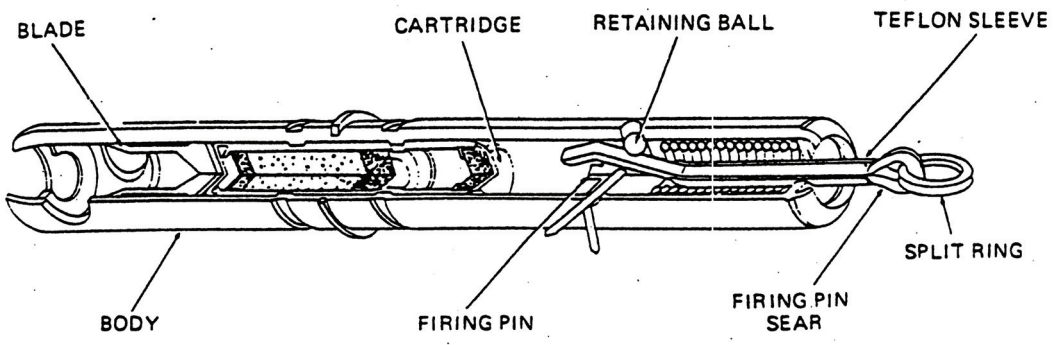


**Figure 11. Cutter**

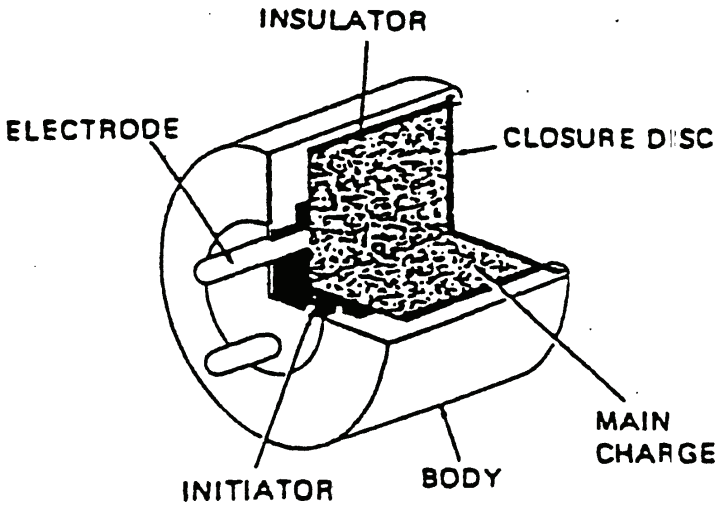


**Figure 12. Aircraft Flare Ejection Cartridge**

# Appendix C:
# CAD/PAD Joint Program Office

## Introduction

The CAD/PAD Joint Program was established by the approval of a Business Plan on April 16, 1998. Final signatories included the Commander, Air Force Aeronautical Systems Center, and Navy Program Executive Officer, Tactical Aircraft Program (PEO (T)).

The Joint Program consolidated the remaining separate Air Force and Navy programs for the sustainment of CAD/PAD. Sustainment includes the range of activities needed to maintain a military system in operational usage, including replenishment acquisition, quality assessment, maintenance, repair, and product improvement.

This final consolidation has resulted in a true life-cycle commodity management program. It encompasses 3,100 distinct DOD CAD/PAD items whose applications include air, surface, and underwater platforms. Approximately 11,000 aircraft are supported which represent 550,000 installed items. The total Fiscal Year 2000 operating budget for the Joint Program was approximately $120 million of which $70 million was earmarked for acquisition involving 400 contracts including 1,400 line items.

## Background

### *Life Cycle Responsibilities*

CAD/PADs are normally developed as a component of a system, with life cycle responsibility residing with the system's acquisition program manager. However, day-to-day CAD/PAD sustainment responsibilities have been delegated within each Service to achieve economies of scale. Navy responsibilities reside with the Conventional Strike Weapons Program Manager (PMA-201), Patuxent River, Maryland that reports to the Program Executive Officer, Strike Weapons and Unmanned Aviation, PEO (W). The Indian Head Division, Naval Surface Warfare Center (NSWC) at Indian Head, Maryland, is responsible for Navy program execution. Prior to this agreement, Air Force responsibility resided with the Air-to-Surface Product Group Manager (PGM) at Ogden Air Logistics Center (ALC), Hill Air Force Base, Utah.

### *Earlier Consolidation Efforts*

In 1974, the Joint Logistics Commanders agreed to consolidate most Army CAD/PAD functions within the Navy and at Indian Head, except requirements determination, budgeting, and inventory control, which continue to be the responsibility of the Operations Support Command, Rock Island, Illinois. The agreement served as the starting point on a long road toward full consolidation of CAD/PAD functions. Subsequent agreements among DOD agencies and organizations involved in CAD/PAD further strengthened the multi-service nature of the program and broadened the Navy's full life cycle role.

#### *Joint Program Initiative*

As a result of downsizing in the 1990s, the Air-to-Surface PGM at Ogden ALC suggested a study to evaluate the feasibility of a Joint Program. Over 1995-1997, an Indian Head and Ogden ALC Implementation Team conducted studies and demonstrations. The Team eventually decided that a Joint Program would be feasible, with the best alternative being the Navy as lead Service, and would boost efficiency. The Team identified several potential benefits, including preserving operational readiness and flight safety; unifying life cycle management and program consolidation; minimizing duplication and optimizing resources; standardizing policies and processes; and effectively managing the industrial base.

### *Organizational Aspects*

Under the Joint Program agreement, the Navy is Lead Service for all CAD/PAD sustainment activities DOD-wide. An important effect of the agreement is to give the Navy responsibility for CAD/PAD sustainment decisions that can affect the readiness of Air Force aircraft. Army CAD/PAD sustainment was previously consolidated under the Navy.

The CAD/PAD Joint Program, based at Indian Head, is structured as an integrated product team managed by a small, jointly manned Program Office, reporting to PMA-201. The Program Office directs a competency-based organization at Indian Head and Ogden ALC, composed of acquisition, logistics, engineering, test and evaluation, and

manufacturing. Administrative reporting and support relationships remain unchanged by Joint Program implementation.

***Advisory Group***

The CAD/PAD Joint Program Advisory Group (JPAG) provides advice to the Joint Program, and accomplishes coordination of CAD/PAD program and technical matters within DOD. The overarching Group functions are to coordinate and harmonize the Service's CAD/PAD programs, ensure timely exchange of program information among the Services; reduce the proliferation of items across the Services; and monitor the health of the industrial base.

From 1992 - 2000, this Group was chartered as the Joint Ordnance Commanders Group, CAD/PAD Ad Hoc Group. It was reconstituted as the JPAG under PEO (W), PMA-201 in 2000. Principal members and their Service organizations are listed in the table below.

| Military Service Organization | Principal Member Organization |
|---|---|
| USAF Aeronautical Systems Center , Wright Patterson AFB, OH | Engineering Directorate, Aircrew Systems Division |
| USAF Human Systems Wing, Brooks AFB, TX | Engineering |
| USAF Ogden Air Logistics Center, Hill AFB, UT | Munitions Directorate, CAD/PAD Division |
| USA Aviation and Missile Command, Redstone Arsenal, AL | Aviation Directorate, Weapons Division |
| USA Operations Support Command, Rock Island, IL | Production (Munitions Acquisition) & Logistics - Surveillance Directorates |
| USNMC Conventional Strike Weapons PM, Patuxent River, MD | USNMC CAD/PAD Deputy Program Manager |
| Indian Head Div, Naval Surface Warfare Center, Indian Head, MD | CAD/PAD Joint Program & Program Management |

# Appendix D:
# Transportation Regulations

[Code of Federal Regulations]
[Title 49, Volume 2]
[Revised as of October 1, 2002]
From the U.S. Government Printing Office via GPO Access
[CITE: 49CFR173.56]

TITLE 49--TRANSPORTATION

CHAPTER I--RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

PART 173--SHIPPERS--GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS--Table of Contents

Subpart C--Definitions, Classification and Packaging for Class 1

Sec. 173.56 New explosives--definition and procedures for classification and approval.

(a) Definition of new explosive. For the purposes of this subchapter a new explosive means an explosive produced by a person who:

(1) Has not previously produced that explosive; or

(2) Has previously produced that explosive but has made a change in the formulation, design or process so as to alter any of the properties of the explosive. An explosive will not be considered a ``new explosive'' if an agency listed in paragraph (b) of this section has determined, and confirmed in writing to the Associate Administrator, that there are no significant differences in hazard characteristics from the explosive previously approved.

(b) Examination, classing and approval. Except as provided in paragraph (j) of this section, no person may offer a new explosive for transportation unless that person has specified to the examining agency the ranges of composition of ingredients and compounds, showing the intended manufacturing tolerances in the composition of substances or design of articles which will be allowed in that material or device, and unless it has been examined, classed and approved as follows:

(1) Except for an explosive made by or under the direction or supervision of the Department of Defense (DOD) or the Department of Energy (DOE), a new explosive must be examined and assigned a recommended shipping description, division and compatibility group, based on the tests and criteria prescribed in Secs. 173.52, 173.57 and 173.58. The person requesting approval of the new explosive must submit to the Associate Administrator a report of the examination and assignment of a recommended shipping description, division, and compatibility group. If the Associate Administrator finds the approval request meets the regulatory criteria, the new explosive will be approved in writing and assigned an EX number. The examination must be performed by a person who is approved by the Associate Administrator under the provisions of subpart H of part 107 of this chapter and who--

(i) Has (directly, or through an employee involved in the examination) at least ten years of experience in the examination, testing and evaluation of explosives;

(ii) Does not manufacture or market explosives, and is not controlled by or financially dependent on any entity that manufactures or markets explosives, and whose work with respect to explosives is limited to examination, testing and evaluation; and

(iii) Is a resident of the United States.

(2) A new explosive made by or under the direction or supervision of a component of the DOD may be examined, classed, and concurred in by:

(i) U.S. Army Technical Center for Explosives Safety (SMCAC-EST), Naval Sea Systems Command (SEA-9934), or Air Force Safety Agency (SEW), when approved by the Chairman, DOD Explosives Board, in accordance with the Department of Defense Explosives Hazard Classification Procedures (TB 700-2); or

(ii) The agencies and procedures specified in paragraph (b)(1) of this section.

(3) A new explosive made by or under the direction or supervision of the Department of Energy (DOE) may be--

(i) Examined by the DOE in accordance with the Explosives Hazard Classification Procedures (TB 700-2), and must be classed and approved by DOE; or

(ii) Examined, classed, and approved in accordance with paragraph (b)(1) of this section.

(4) For a material shipped under the description of ``ammonium nitrate-fuel oil mixture (ANFO)'', the only test required for classification purposes is the Cap Sensitivity Test (Test Method 5(a) prescribed in the Explosive Test Manual). The test must be

performed by an agency listed in paragraph (b)(1), (b)(2), or (b)(3) of this section, the manufacturer, or the shipper. A copy of the test report must be submitted to the Associate Administrator before the material is offered for transportation, and a copy of the test report must be retained by the shipper for as long as that material is shipped. At a minimum, the test report must contain the name and address of the person or organization conducting the test, date of the test, quantitative description of the mixture. including prill size and porosity, and a description of the test results.

(c) Filing DOD or DOE approval report. DOD or DOE must file a copy of each approval, accompanied by supporting laboratory data, with the Associate Administrator and receive acknowledgement in writing before offering the new explosive for transportation, unless the new explosive is:

(1) Being transported under paragraph (d) or (e) of this section; or

(2) Covered by a national security classification currently in effect.

(d) Transportation of explosive samples for examination. Notwithstanding the requirements of paragraph (b) of this section with regard to the transportation of a new explosive that has not been approved, a person may offer a sample of a new explosive for transportation, by railroad, highway, or vessel from the place where it was produced to an agency identified in paragraph (b) of this section, for examination if--

(1) The new explosive has been assigned a tentative shipping description and class in writing by the testing agency;

(2) The new explosive is packaged as required by this part according to the tentative description and class assigned, unless otherwise specified in writing by the testing agency; and,

(3) The package is labeled as required by this subchapter and the following is marked on the package:

(i) The words ``SAMPLE FOR LABORATORY EXAMINATION'';

(ii) The net weight of the new explosive; and

(iii) The tentative shipping name and identification number.

(e) Transportation of unapproved explosives for developmental testing. Notwithstanding the requirements of paragraph (b) of this section, the owner of a new explosive that has not been examined or approved may transport that new explosive from the place where it was produced to an explosives testing range if--

(1) It is not a primary (a 1.1A initiating) explosive or a forbidden explosive according to this subchapter;

(2) It is described as a Division 1.1 explosive (substance or article) and is packed, marked, labeled, described on shipping papers and is otherwise offered for transportation in conformance with the requirements of this subchapter applicable to Division 1.1;

(3) It is transported in a motor vehicle operated by the owner of the explosive; and

(4) It is accompanied by a person, in addition to the operator of the motor vehicle, who is qualified by training and experience to handle the explosive.

(f) Notwithstanding the requirements of paragraphs (b) and (d) of this section, the Associate Administrator may approve a new explosive on the basis of an approval issued for the explosive by the competent authority of a foreign government, or when examination of the explosive by a person approved by the Associate Administrator is impracticable, on the basis of reports of tests conducted by disinterested third parties, or may approve the transportation of an explosives sample for the purpose of examination by a person approved by the Associate Administrator.

(g) Notwithstanding the requirements of paragraph (b) of this section, an explosive may be transported under Secs. 171.11, 171.12, 171.12a or 176.11 of this subchapter without the approval of the Associate Administrator if the Associate Administrator has acknowledged, in writing, the acceptability of an approval issued by the competent authority of a foreign government pursuant to the provisions of the UN Recommendations, the ICAO Technical Instructions, the IMDG Code, or other national or international regulations based on the UN Recommendations. In such a case, a copy of the foreign competent authority approval, and a copy of the written acknowledgement of its acceptance must accompany each shipment of that explosive.

(h) The requirements of this section do not apply to cartridges, small arms which are:

(1) Not a forbidden explosive under Sec. 173.54 of this subchapter;

(2) Ammunition for rifle, pistol, or shotgun;

(3) Ammunition with inert projectile or blank ammunition; and

(4) Ammunition not exceeding 50 caliber for rifle or pistol cartridges or 8 gauge for shotgun shells.

Cartridges, small arms meeting the criteria of this paragraph (h) may be assigned a classification code of 1.4S by the manufacturer.

(i) If experience or other data indicate that the hazard of a material or a device containing an explosive composition is greater or less than indicated according to the definition and criteria specified in Secs. 173.50, 173.56, and 173.58 of this subchapter, the Associate Administrator may specify a classification or except the material or device from the requirements of this subchapter.

(j) Fireworks. Notwithstanding the requirements of paragraph (b) of this section, Division 1.3 and 1.4 fireworks may be classed and approved by the Associate Administrator without prior examination and offered for transportation if the following conditions are met:

(1) The fireworks are manufactured in accordance with the applicable requirements in APA Standard 87-1;

(2) A thermal stability test is conducted on the device by the BOE, the BOM, or the manufacturer. The test must be performed by maintaining the device, or a representative prototype of a large device such as a display shell, at a temperature of 75 deg.C (167 deg.F) for 48 consecutive hours. When a device contains more than one component, those components which could be in physical contact with each other in the finished device must be placed in contact with each other during the thermal stability test; and

(3) The manufacturer applies in writing to the Associate Administrator following the applicable requirements in APA Standard 87-1, and is notified in writing by the Associate Administrator that the fireworks have been classed, approved, and assigned an EX-number. Each application must be complete, including all relevant background data and copies of all applicable drawings, test results, and any other pertinent information on each device for which approval is being requested. The manufacturer must sign the application and certify that the device for which approval is requested conforms to APA Standard 87-1 and that the descriptions and technical information contained in the application are complete and accurate. If the application is denied, the manufacturer will be notified in writing of the reasons for the denial. The Associate Administrator may require that the fireworks be examined by an agency listed in paragraph (b)(1) of this section.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 56 FR 66267,
Dec. 20, 1991; Amdt. 173-234, 58 FR 51532,
Oct. 1, 1993; 62 FR 51560,
Oct. 1, 1997; 63 FR 37461, July 10, 1998; 64 FR 10777, Mar. 5, 1999; 66
FR 45379, Aug. 28, 2001]

[Code of Federal Regulations]
[Title 49, Volume 2]
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TITLE 49--TRANSPORTATION

CHAPTER I--RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

PART 173--SHIPPERS--GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS--Table of Contents

Subpart C--Definitions, Classification and Packaging for Class 1

Sec. 173.57 Acceptance criteria for new explosives.

(a) Unless otherwise excepted, an explosive substance must be subjected to the Drop Weight Impact Sensitivity Test (Test Method 3(a)(i)), the Friction Sensitivity Test (Test Method 3(b)(iii)), the Thermal Stability Test (Test Method 3(c)) at 75 deg.C (167 deg.F) and the Small-Scale Burning Test (Test Method 3(d)(i)), each as described in the Explosive Test Manual (UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (see Sec. 171.7 of this subchapter)). A substance is forbidden for transportation if any one of the following occurs:

(1) For a liquid, failure to pass the test criteria when tested in the Drop Weight Impact Sensitivity Test apparatus for liquids;

(2) For a solid, failure to pass the test criteria when tested in the Drop Weight Impact Sensitivity Test apparatus for solids;

(3) The substance has a friction sensitiveness equal to or greater than that of dry pentaerythrite tetranitrate (PETN) when tested in the Friction Sensitivity Test;

(4) The substance fails to pass the test criteria specified in the Thermal Stability Test at 75 deg.C (167 deg.F); or

(5) Explosion occurs when tested in the Small-Scale Burning Test.

(b) An explosive article, packaged or unpackaged, or a packaged explosive substance must be subjected to the Thermal Stability Test for Articles and Packaged Articles (Test method 4(a)(i)) and the Twelve Meter Drop Test (Test Method 4(b)(ii)), when appropriate, in the Explosive Test Manual. An article or packaged substance is forbidden for transportation if evidence of thermal instability or excessive impact sensitivity is found in those tests according to the criteria and methods of assessing results prescribed therein.

(c) Dynamite (explosive, blasting, type A) is forbidden for transportation if any of the following occurs:

(1) It does not have uniformly mixed with the absorbent material a satisfactory antacid in a quantity sufficient to have the acid neutralizing power of an amount of magnesium carbonate equal to one percent of the nitroglycerin or other liquid explosive ingredient;

(2) During the centrifuge test (Test Method D-2, in appendix D to this part) or the compression test (Test Method D-3 in appendix D to this part), a non-gelatin dynamite loses more than 3 percent by weight of the liquid explosive or a gelatin dynamite loses more than 10 percent by weight of the liquid explosive; or

(3) During the leakage test (Test Method D-1 in appendix D to this part), there is any loss of liquid.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 58 FR 51532,
Oct. 1, 1993; 64 FR 51918, Sept. 27, 1999

# Appendix E:
# Statistical Tables

| Shipments and Operating Income Figures, 2001-2005 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | Total Shipments** (in 000s) | Defense Shipments (in 000s) | Commercial Shipments (in 000s) | Def Shipments % of Total Shipments | Comm Shipments % of Total Shipments | Total Operating Income (in 000s)** | Def Operating Income (in 000s) | Comm Operating Income (in 000s) | Def Operating Income as a % of Def Shipments | Comm Operating Income as a % of Comm Shipments | Def Operating Income as a % of Total Operating Income** | Comm Operating Income as a % of Total Operating Income** |
| **2001** | 834,865 | 203,597 | 630,708 | 24.4% | 75.5% | 59,912 | 21,676 | 34,236 | 10.6% | 5.4% | 36.2% | 57.1% |
| **2002** | 883,394 | 214,433 | 664,741 | 24.3% | 75.2% | 82,660 | 21,346 | 56,253 | 10.0% | 8.5% | 25.8% | 68.1% |
| **2003** | 893,805 | 224,075 | 665,906 | 25.1% | 74.5% | 124,078 | 41,439 | 76,575 | 18.5% | 11.5% | 33.4% | 61.7% |
| **2004** | 999,614 | 228,806 | 767,314 | 22.9% | 76.8% | 166,344 | 42,766 | 115,722 | 18.7% | 15.1% | 25.7% | 69.6% |
| **2005*** | 972,327 | 243,297 | 726,264 | 25.0% | 74.7% | 162,365 | 39,214 | 114,363 | 16.1% | 15.7% | 24.2% | 70.4% |
| **Totals**** | **4,584,006** | **1,114,208** | **3,454,933** | **24.3%** | **75.4%** | **595,359** | **166,441** | **397,150** | n/a | n/a | n/a | n/a |
| **Average** | 916,801 | 222,842 | 690,987 | 24.3% | 75.4% | 119,072 | 33,288 | 79,430 | 14.8% | 11.2% | 29.1% | 65.4% |
| **05 vs. 01** | 16.5% | 19.5% | 15.2% | n/a | n/a | 171.0% | 80.9% | 234.0% | n/a | n/a | n/a | n/a |

* Estimated

** Discrepancies in totals are due to numbers reported

| Employment Figures, 2001-2005 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **YEAR** | **Total Employment** | **Production Workers** | **Production Workers as a % of Total Employment** | **Defense Total Employment** | **Defense Production Workers** | **Def Production Workers as a % of Def Total Employment** | **Commercial Total Employment** | **Commercial Production Workers** | **Comm Production Workers as a % of Comm Total Employment** |
| **2001** | 3,693 | 2,660 | 72.0% | 1,851 | 1,125 | 60.8% | 1,842 | 1,535 | 83.3% |
| **2002** | 4,250 | 3,259 | 76.7% | 1,952 | 1,290 | 66.1% | 2,298 | 1,969 | 85.7% |
| **2003** | 4,337 | 3,382 | 78.0% | 1,853 | 1,213 | 65.5% | 2,484 | 2,169 | 87.3% |
| **2004** | 4,293 | 3,533 | 82.3% | 1,824 | 1,190 | 65.3% | 2,469 | 2,343 | 94.9% |
| **2005*** | 4,005 | 3,059 | 76.4% | 1,823 | 1,184 | 64.9% | 2,182 | 1,875 | 85.9% |
| **Totals**** | **20,576** | **15,894** | n/a | **9,301** | **6,003** | n/a | **11,275** | **9,891** | n/a |
| **Average** | 4,115 | 3,179 | 77.1% | 1,860 | 1,201 | 64.5% | 2,255 | 1,978 | 87.4% |
| **05 vs. 01** | 8.5% | 15.0% | n/a | -1.5% | 5.2% | n/a | 18.5% | 22.1% | n/a |

* Estimated
** Discrepancies in totals are due to numbers reported

| Shipments Per Employee Figures, 2001-2005 | | | | | | |
|---|---|---|---|---|---|---|
| YEAR | Total Industry Shipments Per Employee | Total Industry Shipments Per Production Worker | Defense Shipments Per Employee | Defense Shipments Per Production Worker | Commercial Shipments Per Employee | Commercial Shipments Per Production Worker |
| **2001** | 226,098 | 313,830 | 110,023 | 180,935 | 342,404 | 410,885 |
| **2002** | 207,882 | 271,042 | 109,881 | 166,195 | 289,269 | 337,603 |
| **2003** | 206,112 | 264,263 | 120,958 | 184,690 | 268,078 | 307,011 |
| **2004** | 232,875 | 282,916 | 125,476 | 192,233 | 310,779 | 327,492 |
| **2005*** | 242,778 | 317,858 | 133,459 | 205,487 | 332,843 | 387,341 |
| **Totals**** | **1,115,744** | **1,449,909** | **599,798** | **929,540** | **1,543,374** | **1,770,332** |
| **Average** | 223,149 | 289,982 | 119,960 | 185,908 | 308,675 | 354,066 |
| **05 vs. 01** | 7.4% | 1.3% | 21.3% | 13.6% | -2.8% | -5.7% |
| * Estimated<br>** Discrepancies in totals are due to numbers reported | | | | | | |

| Capital Expenditures and Research & Development Figures, 2001-2005 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **YEAR** | **Capital Expenditures (in 000s)**** | **Plant (in 000s)** | **Mach. & Equip. (in 000s)** | **Cap Exp as a % of Total Shipments** | **Plant as a% of Total Cap Exp** | **Mach. & Equip. as a % of Total Cap Exp** | **Total R&D (in 000s)**** | **Defense R&D (in 000s)** | **Commercial R&D (in 000s)** | **R&D as a % of Total Shipments** | **Defense R&D as a % of Total R&D** | **Commercial R&D as a % of Total R&D** |
| **2001** | 31,154 | 2,626 | 28,528 | 3.7% | 8.4% | 91.6% | 40,091 | 12,366 | 27,725 | 4.8% | 30.8% | 69.2% |
| **2002** | 25,872 | 892 | 24,980 | 2.9% | 3.4% | 96.6% | 35,952 | 7,921 | 28,031 | 4.1% | 22.0% | 78.0% |
| **2003** | 17,929 | 655 | 17,274 | 2.0% | 3.7% | 96.3% | 79,295 | 43,019 | 36,276 | 8.9% | 54.3% | 45.7% |
| **2004** | 39,162 | 2,403 | 36,759 | 3.9% | 6.1% | 93.9% | 75,283 | 35,048 | 40,235 | 7.5% | 46.6% | 53.4% |
| **2005*** | 22,692 | 922 | 21,770 | 2.3% | 4.1% | 95.9% | 71,996 | 34,248 | 37,748 | 7.4% | 47.6% | 52.4% |
| **Totals**** | **136,809** | **7,499** | **129,311** | n/a | n/a | n/a | **302,617** | **132,602** | **170,015** | n/a | n/a | n/a |
| **Average** | 27,362 | 1,500 | 25,862 | 3.0% | 5.1% | 94.9% | 60,523 | 26,520 | 34,003 | 6.5% | 40.3% | 59.7% |
| **05 vs. 01** | -27.2% | -64.9% | -23.7% | 3.7% | 8.4% | 91.6% | 79.6% | 177.0% | 36.2% | 4.8% | 30.8% | 69.2% |

* Estimated
** Discrepancies in totals are due to numbers reported

# Appendix F:
# Survey Instrument

OMB Control No. 0694-0119
Expires 09/30/05

**U.S. Department of Commerce**
**Bureau of Export Administration**

# NATIONAL SECURITY ASSESSMENT OF THE U.S. CARTRIDGE AND PROPELLANT ACTUATED DEVICE INDUSTRY

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## PURPOSE OF THIS ASSESSMENT

The U.S. Department of Commerce, Bureau of Industry and Security (BIS) and the Joint Program Office, Naval Surface Weapons Center, Indian Head, are working together to access the current economic health and global competitiveness of the U.S. cartridge and propellant actuated device industry. The goal of this assessment is to update industry and government officials on the status of this defense critical industry since the earlier BIS assessment completed in 2000.

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## YOUR RESPONSE IS REQUIRED BY LAW

This assessment is conducted pursuant to the Defense Production Act of 1950, as amended (DPA) (50 U.S.C.A. app. section 2061 et. seq. (1997) and as delegated to the Secretary of Commerce in section 401(4) of Executive Order 12656 (3 C.F.R. 585 (1988)). Your response to this questionnaire is required under section 705 of the DPA (50 U.S.C.A. app. section 2155). Any information submitted in response to this questionnaire will be deemed **BUSINESS CONFIDENTIAL** and treated in accordance with section 705 of the DPA.

---

**Burden Estimate and Request for Comment:** Notwithstanding any other provision of law, no person is required to respond to nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a currently valid OMB Control Number.

Public reporting burden for this collection of information is estimated to average 6 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the BIS Reports Clearance Officer, Room 6622, Bureau of Industry and Security, U.S. Department of Commerce, Washington, DC 20230, and/or to the Office of Management and Budget, Paperwork Reduction Project (OMB Control No. 0694-0119), Washington, DC 20503.

# EXEMPTION

If your firm has not produced Cartridge or Propellant Actuated Devices in the United States since January 1, 2001, you are not required to complete this form. If this is the case, please provide the information requested below and return this page.

| | | | | |
|---|---|---|---|---|
| **Name of Company** | **Address** | **City** | **State** | **Zip** |
| **Signature of Authorized Official** | **Date *(Format: mm/dd/yyyy)*** | | | |
| **Name of Official- Please Print** | **Phone Number** | | | |

## SURVEY CONTENTS

## GENERAL INSTRUCTIONS

1. Please complete this questionnaire in its entirety as it applies to your company's Cartridge and Propellant Actuated Device (CAD/PAD) operations. The questionnaire has 4 parts as follows:

| | |
|---|---|
| PART I | Firm Identification |
| PART II | Statistical Profile |
| PART III | Competitiveness |
| PART IV | Effectiveness of Previous Recommendations |

2. It is not our desire to impose an unreasonable burden on any respondent. IF INFORMATION IS NOT READILY AVAILABLE FROM YOUR RECORDS IN EXACTLY THE FORM REQUESTED, FURNISH ESTIMATES AND DESIGNATE BY THE LETTER "E".

3. Report calendar year data, unless otherwise specified in a particular question. Please make photocopies of forms if additional copies are needed.

4. Please use the list of codes on the attached "List of Product Codes" to identify devices in Parts I, II, and III.

5. Questions related to the questionnaire should be directed to Lee Frazier, Senior Trade and Industry Analyst, (202) 482-4253, LFrazier@bis.doc.gov, or Marty Canner, Trade and Industry Analyst, (202) 482-2519, MCanner@bis.doc.gov, at the U.S. Department of Commerce. You may also fax questions to (202) 482-5650.

6. Before returning your completed questionnaire, be sure to sign the certification on the last page and identify the person and phone number to be contacted (if necessary) at your firm. Return questionnaire within 30 days to:

Mr. Brad Botwin
Director, Strategic Analysis Division
Room 3876, BIS/SIES
U.S. Department of Commerce
Washington, DC 20230

## PRODUCT CODES

**1. AIRCREW ESCAPE PROPULSION SYSTEM:** A rocket powered device employed in aircrew escape systems to perform such functions as propulsion, acceleration, deceleration, ejection seat divergence, man-seat separation, parachute deployment, stabilization, etc., including rocket catapults and underseat rocket motors.

**2. IMPULSE CARTRIDGES:** A cartridge-type item employing propellant or explosive materials to release energy. This category includes fire extinguisher cartridges, ignition elements, squibs, detonators and blasting caps, but **excludes** cartridges that incorporate pyrotechnic delay material(s) to affect the timing of the output charge initiation, see product code #4. Also exclude aircraft stores release cartridges and aircraft cartridges and aircraft countermeasure cartridges such as chaff and flare ejection cartridges and sonobouy ejection cartridges (see PRODUCT CODE #5).

**2A. ELECTRICALLY INITIATED CARTRIDGES:** Devices using electrical energy to initiate the energetic material.

**2B. PERCUSSION INITIATED CHARGES:** Devices using percussion primers to initiate the energetic material.

**3. INITIATORS (IMPULSE):** Devices employing energetic materials such as propellants or explosives to: generate the initial or sustaining pressure within a ballistic gas system or to initiate a signal transmission line such as shielded mild detonating cords, thin layered explosive transmission lines, etc. **Exclude** cartridge type devices which are employed in igniters or other explosive devices to ignite propellants or explosives, as well as, initiators which affect the timing of the output charge initiation by use of pyrotechnic delay material(s) (see PRODUCT CODE #4).

**4. DELAY CARTRIDGES AND DELAY INITIATORS:** Devices similar to PRODUCT CODES #2A, #2B AND #3 that incorporates pyrotechnic delay material(s) to effect timing of the output charge initiation. This category includes electric and percussion primed delay cartridges and delay initiators.

**5. AIRCRAFT STORES/ FLARES/ CHAFF/SONOBUOY EJECTION CARTRIDGES:** Cartridges and ignition elements, employing energetic materials such as propellants and explosives, used to eject bombs, sonobuoys, missiles, etc., from combat aircraft. This category includes cartridges to launch or eject aircraft flares or chaff for anti-aircraft missile countermeasures, but not the flares themselves.

**6. DETONATING CORDS AND CHARGES:** This category includes the following devices; shielded mild detonating cord, mild detonating cord, linear shape charge, flexible linear shape charge, mild detonating fuse, and thin layered explosive lines. Also included in this group are transfer assemblies and other assemblies that employ these type of cords or lines, (for example, window severance assemblies). **Exclude** bulk explosives.

**7. CUTTERS:** Devices which employ energetic materials and a cutting blade to sever a bolt, wire, cable suspension line, etc.

**8. CATAPULTS, THRUSTERS, and REMOVERS:** Devices using energetic materials and employing captured or ejected telescoping-type tubes to perform functions such as separation, ejection, thrusting, movement, etc.

**9. OTHER:** This category includes all other cartridges, cartridge actuated devices and other pyrotechnic devices of similar design and used in a similar manner.

**9A.** Automatic Inflators
**9B.** Gas Generators
**9C.** Automotive Airbag Initiators
**9D.** Laser Initiated Cartridges, Detonators, and Initiators
**9E.** Rocket Motor Igniters

## DEFINITIONS

**CARTRIDGE -** An energy source utilizing one or more energetic materials such as pyrotechnic, propellant or explosive ingredients.

**CARTRIDGE ACTUATED DEVICE (CAD)-** A device releasing cartridge energy to perform a controlled system or work function.

**DEFENSE SHIPMENTS** - Direct and indirect military shipments, including domestic and international shipments for military use. These include: 1) weapon systems, support equipment, and all other defense related end-use devices, identified by purchase orders bearing a DO or DX rating and/or a contract number from the Department of Defense, Nuclear Regulatory Commission, Central Intelligence Agency, Federal Aviation Administration, National Security Agency or National Aeronautics and Space Administration; 2) the orders of your customers which you can identify as producing products for defense purposes; and 3) devices tested and certified to military specifications.

**ESTABLISHMENT** - All facilities in which CAD/PADs are produced. Includes auxiliary facilities operated in conjunction with (whether or not physically separate from) such production facilities. Does not include facilities solely involved in distribution.

**FIRM** - An individual proprietorship, partnership, joint venture, association, corporation (including any subsidiary corporation in which more than 50 percent of the outstanding voting stock is owned), business trust, cooperative, trustees in bankruptcy, or receivers under decree of any court, owning or controlling one or more establishments as defined above.

**OFFSET AGREEMENTS -** Offsets are defined as industrial or commercial compensation practices required by foreign governments as a condition of purchase of military imports. Common types of offsets include licensed production of the defense item (or parts thereof) in the purchasing country, technology transfer, foreign investment, and countertrade.

**PROPELLANT ACTUATED DEVICE (PAD) -** A rocket powered device releasing controlled propellant energy to perform a work function. This device provides propulsion for acceleration/deceleration, stabilization, divergence or deployment.

**RESEARCH AND DEVELOPMENT** - Includes basic and applied research and product development in the sciences and in engineering, and design and development of prototype products and processes. For the purposes of this questionnaire, research and development includes activities carried on by persons trained, either formally or by experience, in the physical sciences including related engineering, if the purpose of such activity is to do one or more of the following things:

1. Pursue a planned search for new knowledge, whether or not the search has reference to a specific application.

2. Apply existing knowledge to problems involved in the creation of a new product or process, including work required to evaluate possible uses.

3. Apply existing knowledge to problems involved in the improvement of a product or process.

**SHIPMENTS** - Domestically produced products shipped by your firm during the reporting period. Such shipments should include inter-plant transfers, but should exclude shipments of products produced by other manufacturers for resale under your brand name. Do not adjust for returned shipments. (See definition of DEFENSE SHIPMENTS above.)

**UNITED STATES** - Includes the fifty States, Puerto Rico, District of Columbia, and the Virgin Islands.

**"BUSINESS CONFIDENTIAL"**

**PART I: FIRM IDENTIFICATION**

**1. COMPANY NAME AND ADDRESS**: Please provide the name and address of your firm or corporate division engaged in CAD/PAD operations.

_____
Company Name

_____
Street Address

_____ _____ _____
City State Zip Code

Percent of Company's or Corporate Division's business that is CAD/PAD related:_____%. List all other business activities your company does? (If none, please check here: _____ )

**2. OWNERSHIP**: If your firm is wholly or partly owned by another firm, indicate the name and address of the parent firm and extent of ownership.

_____
Company Name

_____
Street Address

_____ _____ _____ _____
City State Country Zip Code

Extent of Ownership:_____% Year acquired _____

Percent of Parent's business that is CAD/PAD related:_____%

***Are you a wholly-owned subsidiary of a foreign parent company?*** _____

## PART I: FIRM IDENTIFICATION

**3. ESTABLISHMENTS**: Please identify the location of each of your U.S. CAD/PAD manufacturing establishments currently in operation on the top portion of the table, and any CAD/PAD establishments closed or sold since January 1, 2001 on the lower portion. Indicate the product types produced at each using the product codes listed at the beginning of the survey.

| Establishment Locality | State | Zip | Product Type(s) |
|---|---|---|---|
| 1. | | | |
| 2, | | | |
| 3. | | | |
| 4. | | | |
| **Closed or Sold Establishments** | **State** | **Zip** | **Product Type(s)** |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |

**4. PRODUCTION CAPABILITIES:** For CAD/PAD products you ceased producing since January 1, 2001, please place a check mark in the column headed "Ceased Production". In the column headed "Could Produce", place a check mark by those CAD/PAD products your firm could manufacture (excluding products listed under Product Types, in question #3 above) with current equipment and facilities that you are not producing now and the estimated investment required to do so.

| CAD/PAD Product | Ceased Production | Could Produce | Estimated Investment |
|---|---|---|---|
| 1. Aircrew Escape Propulsion System | | | |
| 2a. Electrically Initiated Impulse Cartridges | | | |
| 2b. Percussion Initiated Impulse Charges | | | |
| 3. Initiators (Impulse) | | | |
| 4. Delay Cartridges And Delay Initiators | | | |
| 5. Aircraft Stores/ Flares/ Chaff/ Sonobouy Ejection Cartridges | | | |
| 6. Detonating Cords And Charges | | | |
| 7. Cutters | | | |
| 8. Catapults, Thrusters, Removers | | | |
| 9a. Automatic Inflators | | | |
| 9b. Gas Generators | | | |
| 9c. Automotive Airbag Initiators | | | |
| 9d. Laser Initiated Cartridges, Detonators, and Initiators | | | |
| 9e. Fire Extinguisher Cartridges | | | |

## PART I: FIRM IDENTIFICATION

**5. REASONS FOR CLOSING OR SELLING ESTABLISHMENTS OR CEASING PRODUCT PRODUCTION:** For establishments closed or sold, or product lines no longer produced since January 1, 2001, please cite the reasons for the action below. You may use the codes a-e as shown below if they apply; otherwise please use "f" and briefly explain your answer.

| | |
|---|---|
| a. Loss of market share to imports | d. Inability to comply with environmental regulations |
| b. Loss of market share to domestic competition | e. Inability to comply with safety regulations |
| c. Declining demand | f. Other (Please explain in space provided below) |

| Establishment Closed or Sold* | Year | Reason (use codes) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| **Products No Longer Produced** | **Year** | **Reason (use codes)** |
| | | |
| | | |
| | | |
| | | |
| | | |

***** If an establishment was sold, please indicate to whom in the column headed, "Establishment Closed or Sold".

**6. MERGERS, ACQUISITIONS AND TAKEOVERS:** Please document on the following table any mergers, acquisitions, takeovers, or divestitures that affected the CAD/PAD operations your company was involved in since January 1, 2001.

| Year | Name of Other Firm(s) | Type of Deal* | Objective of Deal* |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

* You may use the following letter codes:

Type of Deal: a. Merger, b. Acquisition, c. Takeover, d. Divestiture e. Other: (specify)
Objective of Deal: a. Expand product offerings, b. Increase share in existing markets, c. Achieve economics of scale, d. Achieve other efficiencies, e. Gain expertise, f. Gain new markets g. Other (specify)

**PART I: FIRM IDENTIFICATION**

**7. CAD/PAD BUSINESS UNIT AND OVERALL FIRM FINANCIAL DATA:** Please provide the data requested for your firm's CAD/PAD Product operations from fiscal year 2001 through fiscal year 2005, estimating 2005 if not yet completed. Your response should be given according to your Firm's fiscal year. If your Firm's financial data is reported by quarter, combine four consecutive quarters to show an annual figure.

Please indicate your fiscal year end: _____ / _____
Month Year

Please enter all monetary figures as whole dollars, separated by commas and without a dollar sign, i.e., 1,5443,250.

| INCOME STATEMENT FOR CAD/PAD BUSINESS UNIT | | | | | |
|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Operating Income | | | | | |
| Defense Operating Income | | | | | |
| Non-Defense Operating Income | | | | | |
| Operating Profit/(Loss) of CAD/PAD Unit | | | | | |
| **BALANCE SHEET FOR CAD/PAD BUSINESS UNIT** | | | | | |
| | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Current Assets | | | | | |
| Non-Current Assets | | | | | |
| Total Assets | | | | | |
| Current Liabilities | | | | | |
| Non-Current Liabilities | | | | | |
| Owner's Equity | | | | | |
| Total Liabilities | | | | | |

| INCOME STATEMENT FOR OVERALL FIRM OPERATIONS | | | | | |
|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Operating Income | | | | | |
| Operating Income Derived From Defense Activity | | | | | |
| Operating Income Derived From Non-Defense Activity | | | | | |
| Operating Profit/(Loss) of Firm | | | | | |
| **BALANCE SHEET FOR FIRM'S OVERALL FIRM OPERATIONS** | | | | | |
| | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Current Assets | | | | | |
| Non-Current Assets | | | | | |
| Total Assets | | | | | |
| Current Liabilities | | | | | |
| Non-Current Liabilities | | | | | |
| Owner's Equity | | | | | |
| Total Liabilities | | | | | |

**PART I: <u>FIRM IDENTIFICATION</u>**

**8. CAD/PAD BUSINESS UNIT INVENTORY AND BACKLOG:** At the close of each respective fiscal year, please indicate the following:

| INVENTORY AND BACKLOG FOR FIRM AND CAD/PAD BUSINESS UNIT | | | | | |
|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Value of Total Firm Inventory | | | | | |
| Value of CAD/PAD Products Inventory | | | | | |
| Value of CAD/PAD Products Backlog | | | | | |

**PART I: FIRM IDENTIFICATION**

**9. PLEDGE OR GUARANTEE:** Are any of your Firm's CAD/PAD Products assets, including accounts receivable and/or earnings, pledge, collateralized or otherwise hypothecated?

☐ Yes ☐ No

Has you Firm's CAD/PAD Products business unit served as a co-signatory, guarantor or co-guarantor for your Firm, your officers and/or directors, and/or any portion or unit of your Firm?

☐ Yes ☐ No

If yes, describe all terms related thereto in detail below:

_____

_____

_____

**10. FIRM GOING CONCERN:** At any time during each respective fiscal year has an internal or independent auditor expressed doubt over your firm's ability to remain a Going Concern?

| GOING CONCERN (FIRM) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | |
| | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Has your Firm lost its ability to remain a going concern? | | | | | | | | | | |

If yes, please describe the reasons for such a concern below:

_____

_____

_____

**11. BUSINESS UNIT GOING CONCERN:** At any time during each respective fiscal year has an internal or independent auditor expressed doubt over your CAD/PAD Products Business Unit's ability to remain a Going Concern?

| GOING CONCERN (CAD/PAD BUSINESS UNIT) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | |
| | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Has your CAD/PAD Business Unit lost its ability to remain a going concern? | | | | | | | | | | |

If yes, please describe the reasons for such a concern below:

_____

_____

_____

**PART II: STATISTICAL PROFILE**

**The following two pages contain tables to be completed for 1) Total CAD/PAD Shipments (Table 1) and 2) CAD/PAD Exports (Table 2).**

**Table 1 -**

1. **TOTAL CAD/PAD SHIPMENTS, INCLUDING EXPORTS:** Please report separately your total defense (upper portion of table) and non-defense (lower portion of table) shipments for each of the listed CAD/PAD devices in the designated areas of the table for the years 2001-2004, and estimated totals for 2005.

   Please include exports to foreign defense or military applications as defense shipments and include in upper portion of table.

   At the bottom of the table, report, (1) the combined total of all CAD/PAD shipments (including exports); and (2) net income before taxes for your CAD/PAD operations.

   Please report values in thousands ($000's) of dollars, except for net income, which should be reported as a percentage of CAD/PAD shipments.

"BUSINESS CONFIDENTIAL"

## PART II: STATISTICAL PROFILE

| TABLE 1. TOTAL DEFENSE or MILITARY RELATED SHIPMENTS (in $000s)* | | | | | |
|---|---|---|---|---|---|
| **Products** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| 1. Aircrew Escape Propulsion Subsystem | | | | | |
| 2a. Electrically Initiated Impulse Cartridge | | | | | |
| 2b. Percussion Initiated Impulse Cartridge | | | | | |
| 3. Initiators (Impulse) | | | | | |
| 4. Delay Cartridges And Delay Initiators | | | | | |
| 5. Aircraft Stores, Flares, Chaff, Sonobouy Ejection Cartridges | | | | | |
| 6. Detonating Cords And Charges | | | | | |
| 7. Cutters | | | | | |
| 8. Catapults, Thrusters, Removers | | | | | |
| 9a. Automatic Inflators | | | | | |
| 9b. Gas Generators | | | | | |
| 9c. Automotive Airbag Initiators | | | | | |
| 9d. Laser Initiated Cartridges, Detonators, and Initiators | | | | | |
| 9e. Rocket Motor Igniters | | | | | |
| **TOTAL NON-DEFENSE or COMMERCIAL RELATED SHIPMENTS (in $000s)**** | | | | | |
| **Products** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| 2a. Electrically Initiated Impulse Cartridge | | | | | |
| 2b. Percussion Initiated Impulse Cartridge | | | | | |
| 3. Initiators (Impulse) | | | | | |
| 4. Delay Cartridges And Delay Initiators | | | | | |
| 6. Detonating Cords And Charges | | | | | |
| 7. Cutters | | | | | |
| 9a. Automatic Inflators | | | | | |
| 9b. Gas Generators | | | | | |
| 9c. Automotive Airbag Initiators | | | | | |
| 9d. Laser Initiated Cartridges, Detonators, and Initiators | | | | | |
| 9e. Rocket Motor Igniters | | | | | |
| **Grand Total and Net Income** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| CAD/PAD Shipments: Grand Total | | | | | |
| CAD/PAD Net Income before taxes** | **%** | **%** | **%** | **%** | **%** |

* Note that Products #1, 5, and 8, which are solely for the military, are excluded from the non-defense portion of the table
**Please express (or estimate) net income as a percent return on CAD/PAD shipments (e.g., 8 = 8 percent)

**PART II: STATISTICAL PROFILE Table 2 –**

**2. TOTAL EXPORTS:** Please report separately defense (upper portion of table) and non-defense (lower portion of table) exports of CAD/PAD devices manufactured by your firm for the years 2001-2004, and the estimated totals for 2005, on the table below.
At the bottom of the table, please report total exports. Please report values in thousands ($000's) of dollars.

**Note: Please ensure exports are included in total shipments in your response to Table 1.**

| TABLE 2. DEFENSE or MILITARY RELATED EXPORTS (in $000s) | | | | | |
|---|---|---|---|---|---|
| **Products** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| 1. Aircrew Escape Propulsion Subsystem | | | | | |
| 2a. Electrically Initiated Impulse Cartridge | | | | | |
| 2b. Percussion Initiated Impulse Cartridge | | | | | |
| 3. Initiators (Impulse) | | | | | |
| 4. Delay Cartridges And Delay Initiators | | | | | |
| 5. Aircraft Stores, Flares, Chaff, Sonobouy Ejection Cartridges | | | | | |
| 6. Detonating Cords And Charges | | | | | |
| 7. Cutters | | | | | |
| 8. Catapults, Thrusters, Removers | | | | | |
| 9a. Automatic Inflators | | | | | |
| 9b. Gas Generators | | | | | |
| 9c. Automotive Airbag Initiators | | | | | |
| 9d. Laser Initiated Cartridges, Detonators, and Initiators | | | | | |
| 9e. Rocket Motor Igniters | | | | | |
| **NON-DEFENSE or COMMERCIAL RELATED EXPORTS (in $000s)*** | | | | | |
| **Products** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| 2a. Electrically Initiated Impulse Cartridge | | | | | |
| 2b. Percussion Initiated Impulse Cartridge | | | | | |
| 3. Initiators (Impulse) | | | | | |
| 4. Delay Cartridges And Delay Initiators | | | | | |
| 6. Detonating Cords And Charges | | | | | |
| 7. Cutters | | | | | |
| 9a. Automatic Inflators | | | | | |
| 9b. Gas Generators | | | | | |
| 9c. Automotive Airbag Initiators | | | | | |
| 9d. Laser Initiated Cartridges, Detonators, and Initiators | | | | | |
| 9e. Rocket Motor Igniters | | | | | |
| **Grand Total and Net Income** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| CAD/PAD Exports: Grand Total | | | | | |

* Note that Products #1, 5, and 8, which are solely for the military, are excluded from the non-defense portion of the table

## PART II: STATISTICAL PROFILE

**3. NUMBER OF EMPLOYEES BY OCCUPATION:** Please enter the number of employees by occupation as shown below for year end 2001-2004, and estimates for 2005, for your U.S. CAD/PAD operations, as requested below.

| NUMBER OF EMPLOYEES BY OCCUPATION | | | | | |
|---|---|---|---|---|---|
| **Occupation** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Management | | | | | |
| Program Management | | | | | |
| Contracts Administration | | | | | |
| Purchasing/Procurement | | | | | |
| Sales/Marketing | | | | | |
| Design Engineering | | | | | |
| Manufacturing | | | | | |
| Quality | | | | | |
| Test | | | | | |
| Finance/Accounting | | | | | |
| **Total Direct Employees** | | | | | |
| Outside Consultants | | | | | |
| **Total, with Consultants** | | | | | |

**Definitions:**

| | |
|---|---|
| Management | President, Vice President, Director |
| Program Management | Typically used in matrix organization includes managers, program administrators, program budget analysts |
| Contracts Administration | Including managerial, contracts administrators |
| Purchasing/Procurement | Including managers, buyers |
| Sales/Marketing | Marketing and sales staff plus related secretarial, advertising, trade show, market admin personnel |
| Design Engineering | Direct charge |
| Manufacturing | Includes managers, supervisors, leads, all non-exempt, production control and other direct mfg. |
| Quality | Includes quality engineers, all incoming and in -process inspectors |
| Test | Includes test engineers, technicians, test equipment operators |
| Finance/Accounting | Includes all accounting functions including payroll, |
| Human Resources | Overhead staff |
| Outside Consultants | Any technical, business, quality, legal, or other capacities |

**PART II: STATISTICAL PROFILE**

**4. TECHNICAL SKILLS BASE:** What is the number and current experience profile of your design and engineering technical staff? Please identify below only design engineering staff, excluding engineers in support of manufacturing, testing, quality, and other operations.

| Design Engineering Staff Experience | | | | | | |
|---|---|---|---|---|---|---|
| **Degree/Capacity** | **Number Employed** | **Years of Experience** | | | | |
| | | **<5** | **6 - 10** | **11 - 20** | **21 - 30** | **>30** |
| Mechanical | | | | | | |
| Electrical | | | | | | |
| Chemical | | | | | | |
| Laser | | | | | | |
| **Subtotal** | | | | | | |
| Outside Consultants | | | | | | |
| **Total** | | | | | | |

***Does your manufacturing require special technical skills?*** _____
***If yes, what percentage of new employees possesses these skills?*** _____
***How long does it take to train a new manufacturing employee?*** _____

**PART II: STATISTICAL PROFILE**

**5. SKILLED WOKER AGE RANGES:** Please provide the number of your Firm's CAD/PAD Product staff for 2005, or the last full Fiscal Year if your 2005 Fiscal Year has not been completed, that fall within the functions and age ranges listed in the table below. Non-U.S. citizens include Green Card and H1-B Visa holders.

| SKILLED WORKER AGE RANGES | | | |
|---|---|---|---|
| | **< 35 Years Old** | **35 to 50 years old** | **> 50 years old** |
| U.S. Citizens (Development Staff, i.e. Engineers) | | | |
| Non-U.S. Citizens (Development Staff, i.e. Engineers) | | | |
| U.S. Citizens (Research Staff, i.e. Scientists) | | | |
| Non-U.S. Citizens (Research Staff, i.e. Scientists) | | | |

Have you added any new employees since January 1, 2005?

☐ Yes ☐ No

Do any of your manufacturing processes require special technical skills?

☐ Yes ☐ No

If yes, what percentage of new manufacturing employees hired after January 1, 2005 possess these skills? _____ %

On average, how long does it take to train a new manufacturing employee (in weeks)? _____

**6. TERMINATIONS/LAY-OFFS**: Between January 1, 2001 and 2005 (inclusive), were any full-time employees or consultants of your Firm permanently terminated or temporarily laid-off as a result of declining sales of the CAD/PAD Product business unit? Do not include employees separated for performance or cause.

| TERMINATIONS / LAY-OFFS | | | | | |
|---|---|---|---|---|---|
| | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Terminated | | | | | |
| Laid-Off | | | | | |

**PART II: STATISTICAL PROFILE**

**7. DEVELOPMENT/RESEARCH STAFF DEGREE STATUS**: Please provide the number and highest degree type of your Firm's CAD/PAD Product development/research staff for 2005, or the last full Fiscal Year if your 2005 Fiscal Year has not been completed. Do not include outside consultants not permanently employed by your Firm.

| RESEARCH AND DEVELOPMENT STAFF DEGREE STATUS | | | | |
|---|---|---|---|---|
| | **B.A.** | **Masters** | **Ph.D.** | **Post-Doc** |
| U.S. Citizens (Development Staff, i.e. Engineers) | | | | |
| Non-U.S. Citizens (Development Staff, i.e. Engineers) | | | | |

| | | | | |
|---|---|---|---|---|
| U.S. Citizens (Research Staff, i.e. Scientists) | | | | |
| Non-U.S. Citizens (Research Staff, i.e. Scientists) | | | | |

**8. CUSTOMER TECHNICAL CAPABILITY:** Based on your experience, what trends have you observed about the following technical capabilities within DOD/Primes in the:

a. **Preparation of technical specifications**:

☐ improved ☐ remained about the same ☐ eroded

b. **Technical knowledge of your product**:

☐ improved ☐ remained about the same ☐ eroded

c. **Technical discussion of ordnance application in their system**:

☐ improved ☐ remained about the same ☐ eroded

d. **Technical ability to evaluate proposed design and compare**:

☐ improved ☐ remained about the same ☐ eroded

**PART II: <u>STATISTICAL PROFILE</u>**

**9. OTHER LABOR CONCERNS**: If in the **last five years** you experienced any labor concerns, such as shortages of certain skills, excessive turnover, retirement of experienced workers, liability claims, etc. that adversely affect(ed) your CAD/PAD manufacturing or R&D operations, please describe them below:

_____

_____

_____

**10. INVESTMENT**: Enter expenditures for plants, new machinery, and equipment, and used or rebuilt machinery and equipment (in $000) from 2001 to 2004, and projected amounts for 2005, in the table below.

| NEW INVESTMENT IN CAD/PAD OPERATIONS | | | | | |
|---|---|---|---|---|---|
| **Type Investment** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Plant | | | | | |
| Machinery and Equipment | | | | | |
| Total New Investment | | | | | |

## PART II: STATISTICAL PROFILE

**11. STRATEGIES FOR INVESTMENT:** Based on your last three years experience, please rank from 1-5, the top five motives for investment as shown in the left column. If the motives shown do not apply to all situations, please use "other" reasons.

| Motives for New Investment | Top Five Ranking (1 to 5) |
|---|---|
| Replace old equipment | |
| Improve productivity | |
| Expand capacity | |
| Add new capability | |
| Upgrade technology | |
| Meet specific customer requirements | |
| Comply with environmental or safety requirements | |
| Other (specify): | |

**12. CAD/PAD RESEARCH AND DEVELOPMENT EXPENDITURES:** Please enter your firm's CAD/PAD related research and development (R&D) expenditures from 2001-2004, and projected for 2005 as requested below. Please report your defense related R&D on the bottom half of the following table. Separately enter the dollar amounts (in $000) expended for: 1) materials, 2) processing, and 3) product development. (See definition of Research and Development.)

| COMMERCIAL RESEARCH AND DEVELOPMENT EXPENDITURES (in $000) | | | | | |
|---|---|---|---|---|---|
| **Commercial** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Materials | | | | | |
| Production Processing | | | | | |
| Product Development | | | | | |
| **Total** | | | | | |

| DEFENSE RESEARCH AND DEVELOPMENT EXPENDITURES (in $000) | | | | | |
|---|---|---|---|---|---|
| **Defense** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| Materials | | | | | |
| Production Processing | | | | | |
| Product Development | | | | | |
| **Total** | | | | | |

**PART II: STATISTICAL PROFILE**

**13. R&D APPLICATIONS:** Please provide the value (in $000s) of R&D conducted for defense projects applicable to your commercial operations, and provide the value of commercial R&D of use in your defense operations.

| DEFENSE VS. COMMERCIAL R&D (in $000s) | | |
|---|---|---|
| | **2004** | **E 2005** |
| Defense applicable to Commercial | | |
| Commercial applicable to Defense | | |

**PART II: STATISTICAL PROFILE**

**14. SOURCES OF R&D FUNDING:** Please enter research and development expenditures, by source of funding, from 2001 through 2005 (estimated).

| Sources of CAD/PAD R&D Funding | | | | | |
|---|---|---|---|---|---|
| FUNDING FOR COMMERCIAL R&D (in $000) | | | | | |
| **Funding Source** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| In-House (self-funded) | | | | | |
| Private U.S. Customer | | | | | |
| Private Foreign Customer | | | | | |
| U.S. Army | | | | | |
| U.S. Navy | | | | | |
| U.S. Air Force | | | | | |
| Other DOD | | | | | |
| Other Federal Government | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Foreign Government | | | | | |
| Foreign University | | | | | |
| U.S. University | | | | | |
| Parent Company | | | | | |
| Non-Gov't Org (Non-Profit) | | | | | |
| Subcontractor | | | | | |
| Other: | | | | | |
| Total Funding | | | | | |

If "Other" above, please specify source and amount

## PART II: STATISTICAL PROFILE

| Sources of CAD/PAD R&D Funding | | | | | |
|---|---|---|---|---|---|
| **FUNDING FOR DEFENSE R&D (in $000)** | | | | | |
| **Funding Source** | **2001** | **2002** | **2003** | **2004** | **E 2005** |
| In-House (self-funded) | | | | | |
| Private U.S. Customer | | | | | |
| Private Foreign Customer | | | | | |
| U.S. Army | | | | | |
| U.S. Navy | | | | | |
| U.S. Air Force | | | | | |
| Other DOD | | | | | |
| Other Federal Government | | | | | |
| Foreign Government | | | | | |
| Foreign University | | | | | |
| U.S. University | | | | | |
| Parent Company | | | | | |
| Non-Gov't Org (Non-Profit) | | | | | |
| Subcontractor | | | | | |
| Other: | | | | | |
| Total Funding | | | | | |

If "Other" above, please specify source and amount

**PART II: STATISTICAL PROFILE**

**15. QUALITY STANDARDS:** Is your firm certified to the following quality standard(s)? (Please place a check mark in the appropriate box below.)

| | | | |
|---|---|---|---|
| ISO 9001 | Yes | No | working toward |
| Six Sigma | Yes | No | working toward |
| Mil-Q- 9858A | Yes | No | working toward |
| NASA Handbook 5300 | Yes | No | working toward |
| Other (specify:_____ ) | Yes | No | working toward |

**PART III: COMPETITIVENESS**

**1. COMPETITIVE PROSPECTS:** How do you foresee the competitive prospects for your firm's U.S.-based CAD/PAD production operations over the next five years? (Please check the appropriate box)

My firm's competitiveness should:

☐ ☐ ☐ ☐ ☐

Improve greatly Improve somewhat Stay the same Decline somewhat Decline greatly

Please discuss the basis for your answer.

_____

_____

**2. MERGERS AND ACQUISITIONS:** What is the impact of recent consolidations among competitors on your company? Do you think it will significantly affect your ability to remain competitive?

_____

_____

**PART III: COMPETITIVENESS**

**3. INTERNATIONAL COMPETITORS**: Who are your primary international competitors?

_____

_____

Against international competitors, how would you assess your competitiveness in the last 5 years

My firm's competitiveness:

☐ ☐ ☐ ☐ ☐

Improved greatly Improved somewhat Stayed the same Declined somewhat Declined greatly

**4. GOVERNMENT POLICIES:** With respect to CAD/PAD operations, what reasonable adjustments could be made to the following U.S. Government policies laws, and regulations that would moderate any competitive disadvantages that U.S. firms might face as a result of these policies, laws, and regulations? (Please attach additional sheets if you require additional space.)

a. Procurement:

b. Small Business Set Asides:

c. Small Business Innovative Research Program:

d. Build to Print vs. Performance Specifications:

e. Lot Acceptance Testing:

f. Competitive Bidding:

g. Government Competition:

h. Export Controls:

i. Environmental and Safety Regulations:

j. Research and Development:

k. Shipping Classifications:

l. Other:

**PART III: COMPETITIVENESS**

**5. EFFECTS OF IMPORTS ON CAD/PAD MANUFACTURING:** How have imports of CADs and PADs (including those for your own use) positively and negatively affected your domestic manufacturing operations?

a. **Positive Effects:** (e.g. lower costs, expanded markets, improved efficiency, access to foreign markets, etc.) Please explain below.

b. **Negative Effects**: (e.g. product lines dropped, customers lost, retired capacity, laid-off work force, etc.). Please explain below.

**6. SHORTAGES OF PURCHASED MATERIALS, PARTS AND COMPONENTS:** If you experienced any shortages or supply interruptions of materials, parts and components or other essential supplies in the last five years that adversely affected, or that continue to adversely affect your U.S. manufacturing operations, please describe them below, and the actions you took/are taking to resolve them.

## PART III: COMPETITIVENESS

**7. FOREIGN SOURCES:** Please complete the following table for materials, parts, and manufacturing equipment used in your CAD/PAD operations from foreign sources.

| CAD/PAD Item | Foreign Producer | Country of Origin | Reason Foreign Sourced* |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |
| | | | |

*Reason Foreign Sourced:

a. No known domestic source, b. Domestic source inadequate, c. Supplement to domestic source, d. Lower cost, e. Quicker delivery, g. Better quality/reliability, h. Other (specify)

## PART IV: EFFECTIVENESS OF PREVIOUS RECOMMENDATIONS

EVALUATION OF PREVIOUS RECOMMENDATIONS (COMPANY PERSPECTIVE): The 1995 and 2000 CAD/PAD Assessments made several recommendations. Please review the questions in the left column and put a check mark in the appropriate box on the right column with respect to your experience with the implementation of these recommendations.

| | | | | |
|---|---|---|---|---|
| 1. Have you experienced an improvement in your relations with the CAD/PAD Joint Program Office? | ☐ yes | ☐ no | ☐ do not know | ☐ not applicable |
| 2. Has the CAD/PAD Joint Program Office provided Defense Budget forecasts for CAD/PAD devices? | ☐ yes | ☐ no | ☐ do not know | ☐ not applicable |
| 3. Has the CAD/PAD Joint Program Office briefed you on technical developments and new requirements? | ☐ yes | ☐ no | ☐ do not know | ☐ not applicable |
| 4. Has the CAD/PAD Joint Program Office provided a forum for you to discuss and address grievances? | ☐ yes | ☐ no | ☐ do not know | ☐ not applicable |
| 5. Have you experienced an improvement in your relations with the Labor Dept.'s Office of Safety and Health Admin. (OSHA)? | ☐ yes | ☐ no | ☐ do not know | ☐ not applicable |
| 6. Have you experienced an improvement in your relations with the State Dept.'s Export Control Branch? | ☐ yes | ☐ no | ☐ do not know | ☐ not applicable |
| 7. Have you experienced an improvement in your relations with the Environmental Protection Agency (EPA)? | ☐ yes | ☐ no | ☐ do not know | ☐ not applicable |
| 8. Has the CAD/PAD Joint Program Office contracted out a larger portion of product development and improvement to the CAD/PAD industry? | yes | no | do not know | not applicable |
| 9. Has the CAD/PAD Joint Program Office implemented other policies that improved the CAD/PAD procurement environment? | ☐ | ☐ | ☐ | ☐ |
| | yes | no | do not know | not applicable |
| | | | | |
| 10. Is the lot acceptance testing process working well, or does it need improvement? | | | Working well | Needs improvement |
| | | | | |
| 11. In your opinion, does industry receive at least 90 percent of overall CAD-PAD orders? | Yes | No | | |

| | | | | |
|---|---|---|---|---|
| 12. Are the Technical Exchange Workshops hosted by the CAD/PAD Joint Program Office useful to you, or do they need improvement? | | | Useful | Need Improvement |
| 13. Does second-sourcing of CAD-PAD business help or hurt your company? | Helps | Hurts | Neither | |
| | | | | |

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**CERTIFICATION**

The undersigned certifies that the information herein supplied in response to this questionnaire is complete and correct to the best of his/her knowledge. The U.S. Code, Title 18 (Crimes and Criminal Procedure), Section 1001, makes it a criminal offense to willfully make a false statement or representation to any department or agency of the United States Government as to any matter within its jurisdiction.

_____ _____

Signature of Authorized Official Date

_____

Area Code/Telephone Number

_____

Type or Print Name and Title of Authorized Official

_____

Type or Print Name and Title of Person to Contact re this Report

_____

Area Code/Telephone Number

**Please check here ( ) if you would like to receive a free copy of the final report.**

**"BUSINESS CONFIDENTIAL"**

## GENERAL COMMENTS

Is there any other information that we did not request above or that you would like to offer that you believe would be important for this national security assessment of the U.S. CAD/PAD industry? Please use the space to provide any additional comments or information regarding your operations, or other related issues that impact your firm.

# Appendix G: Evaluation of Previous Reports' Recommendations (Company Perspective)

| | YES | NO | NOT APPLICABLE | DO NOT KNOW |
|---|---|---|---|---|
| **1. Have you experienced an improvement in your relations with the CAD/PAD Joint Program Office?** | 50% (8 of 16) | 25% (4 of 16) | 12.5% (2 of 16) | 12.5% (2 of 16) |
| **2. Has the CAD/PAD Joint Program Office provided defense budget forecasts for CAD/PAD devices?** | 37.5% (6 of 16) | 25% (4 of 16) | 6.25% (1 of 16) | 31.25% (5 of 16) |
| **3. Has the CAD/PAD Joint Program Office briefed you on technical developments and new requirements?** | 75% (12 of 16) | 18.75% (3 of 16) | 6.25% (1 of 16) | - |
| **4. Has the CAD/PAD Joint Program Office provided a forum for you to discuss and address grievances?** | 75% (12 of 16) | 6.25% (1 of 16) | 12.5% (2 of 16) | 6.25% (1 of 16) |
| **5. Have you experienced an improvement in your relations with the Labor Dept.'s Office of Safety and Health Admin. (OSHA)?** | 12.5% (2 of 16) | 12.5% (2 of 16) | 25% (4 of 16) | 50% (8 of 16) |
| **6. Have you experienced an improvement in your relations with the State Dept.'s Export Control Branch?** | 6.25% (1 of 16) | 50% (8 of 16) | 18.75% (3 of 16) | 25% (4 of 16) |
| **7. Have you experienced an improvement in your relations with the Environmental Protection Agency (EPA)?** | 12.5% (2 of 16) | 18.75% (3 of 16) | 12.5% (2 of 16) | 56.25% (9 of 16) |

| | | | | |
|---|---|---|---|---|
| **8. Has the CAD/PAD Joint Program Office contracted out a larger portion of product development and improvement to the CAD/PAD industry?** | 6.25% (1 of 16) | 37.5% (6 of 16) | 6.25% (1 of 16) | 50% (8 of 16) |
| **9. Has the CAD/PAD Joint Program Office implemented other policies that improved the CAD/PAD procurement environment?** | 26.67% (4 of 15) | 33.33% (5 of 15) | 6.67% (1 of 15) | 33.33% (5 of 15) |
| **10. In your opinion, does private industry receive at least 90 percent of overall U.S. CAD-PAD orders?** | 66.67% (8 of 12) | 25% (3 of 12) | - | 8.33% (1 of 12) |
| **11. Does the 'lot acceptance testing process' need improvement?** | 14.3% (2 of 14) | 85.7% (12 of 14) | - | - |
| | **USEFUL** | **NEEDS IMPROVEMENT** | | |
| **12. Are the Technical Exchange Workshops hosted by the CAD/PAD Joint Program Office useful to you, or do they need improvement?** | 85.7% (12 of 14) | 14.3% (2 of 14) | - | - |
| | **HELPS** | **HURTS** | **NEITHER** | |
| **13. Does 'second-sourcing' of CAD-PAD business help or hurt your company?** | 43.75% (7 of 16) | 37.5% (6 of 16) | 18.75% (3 of 16) | - |

# Appendix H:
# U.S. Department of Commerce, BIS/SIES Publication List

**OFFICE OF STRATEGIC INDUSTRIES AND ECONOMIC SECURITY**
**STRATEGIC ANALYSIS DIVISION**

# PUBLICATIONS LIST

**September 11, 2006**

The U.S. Department of Commerce's Strategic Analysis Division is the focal point within the Department for conducting assessments of defense-related industries and technologies. The studies are based on detailed industry-specific surveys used to collect information from U.S. companies and are conducted on behalf of the U.S. Congress, the military services, industry associations, or other interested parties.

| PUBLICATION TITLE | *__Italics__ indicate forthcoming studies |
|---|---|
| ***Global Availability of State-of-the-Art Semiconductor Manufacturing Equipment – December 2007*** | |
| ***Domestic Industrial Base Capabilities for Defense Mission-Critical Microchips – December 2007*** | |
| ***11th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 – December 2006*** | |
| Defense Industrial Base Assessment: U.S. Imaging and Sensors Industry – July 2006 | |
| National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Third Review – July 2006 | |
| 10th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 – December 2005 | |
| Economic Impact Assessment - Air Force C-17 Program – December 2005 | |
| 9th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 – March 2005 | |
| National Security Assessment of the Munitions Power Sources Industry – December 2004 | |
| Offsets in Defense Trade and the U.S. Subcontractor Base – August 2004 | |
| 8th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 – July 2004 | |
| National Security Assessment of the Air Delivery (Parachute) Industry – May 2004 | |
| Industry Attitudes on Collaborating with DoD in R&D – Air Force – January 2004 | |
| Army Theater Support Vessel Procurement: Industrial Base/Economic Impact Assessment – December 2003 | |
| A Survey of the Use of Biotechnology in U.S. Industry – October 2003 | |
| U.S. Textile and Apparel Industries: An Industrial Base Assessment – October 2003 | |
| 7th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 - July 2003 | |
| Technology Assessment: U.S. Assistive Technology Industry – February 2003 | |
| 6th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 - February 2003 | |
| Heavy Manufacturing Industries: Economic Impact and Productivity of Welding – Navy – June 2002 | |
| The Effect of Imports of Iron Ore and Semi-Finished Steel on the National Security – October 2001 | |
| National Security Assessment of the U.S. High-Performance Explosives & Components Sector –June 2001 | |
| National Security Assessment of the U.S. Shipbuilding and Repair Industry - May 2001 | |
| Statistical Handbook of the Ball and Roller Bearing Industry (Update) - June 2001 | |
| 5th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 - May 2001 | |
| National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Update - December 2000 | |

| |
|---|
| The Effect on the National Security of Imports of Crude Oil and Refined Petroleum Products - November 1999 |
| 4th Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 - October 1999 |
| U.S. Commercial Technology Transfers to The People's Republic of China – January 1999 |
| Critical Technology Assessment: Optoelectronics - October 1998 |
| 3rd Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 - August 1998 |
| National Security Assessment of the Emergency Aircraft Ejection Seat Sector - November 1997 |
| 2nd Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 – August1997 |
| Critical Technology Assessment of the U.S. Semiconductor Materials Industry - April 1997 |
| 1st Offsets in Defense Trade - Conducted under §309 of the Defense Production Act of 1950 - May 1996 |
| National Security Assessment of the Cartridge and Propellant Actuated Device Industry - October 1995 |
| A Study of the International Market for Computer Software with Encryption – NSA -1995 |
| The Effect of Imports of Crude Oil and Petroleum Products on the National Security - December 1994 |
| Critical Technology Assessment of U.S. Artificial Intelligence - August 1994 |
| Critical Technology Assessment of U.S. Superconductivity - April 1994 |
| Critical Technology Assessment of U.S. Optoelectronics - February 1994 |
| Critical Technology Assessment of U.S. Advanced Ceramics - December 1993 |
| Critical Technology Assessment of U.S. Advanced Composites - December 1993 |
| The Effect of Imports of Ceramic Semiconductor Packages on the National Security - August 1993 |
| National Security Assessment of the U.S. Beryllium Industry - July 1993 |
| National Security Assessment of the Antifriction Bearings Industry - February 1993 |
| National Security Assessment of the U.S. Forging Industry - December 1992 |
| The Effect of Imports of Gears and Gearing Products on the National Security - July 1992 |
| Natl. Sec. Assessment of the Dom. and For. Subcontractor Base~3 US Navy Systems - March 1992 |
| Natl. Security Assessment of the U.S. Semiconductor Wafer Processing Equipment Industry - April 1991 |
| National Security Assessment of the U.S. Robotics Industry - March 1991 |
| National Security Assessment of the U.S. Gear Industry - January 1991 |

| **Archived Studies** | |
|---|---|
| The Effect of Imports of Uranium on the National Security – Sept. 1989 | Investment Castings: A Natl. Security Assessment – Dec. 1987 |
| The Effect of Imports of Crude Oil and Refined Petroleum on Natl. Security – Jan. 1989 | Joint Logistics Commanders/DOC Precision Optics Study - June 1987 |
| The Effect of Imports of Plastic Injection Molding Machines on Natl. Security – Jan. 1989 | An Economic Assessment of the U.S. Industrial Fastener Industry – Mar. 1987 |
| The Effect of Imports of Anti-Friction Bearings on the Natl. Security - July 1988 | Joint Logistics Commanders/DOC Bearing Study - June 1986 |

**For further information about the Division's programs or for additional copies of reports, please visit us at: http://www.bis.doc.gov/ and select "Defense Industrial Base Programs," or contact:**

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